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NINETEENTH YEAR.

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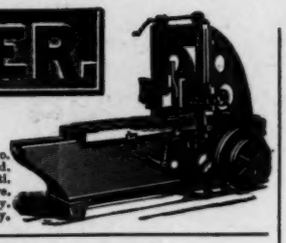

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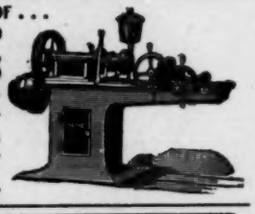

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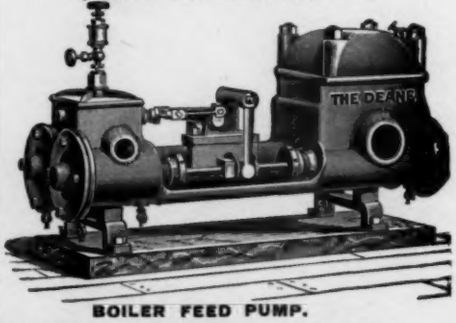

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Molding Machines and Air Hoists.

BY JOHN RANDOL.

The name "molding machine" is applied to at least two entirely distinct apparatuses, each aiding in the rapid production of green-sand molds for metal-founding, but so entirely unlike in operation that in one case the action of the machine affects the sand only, and in the other the machine action is simply to draw the pattern from the sand, which is shoveled and riddled into the flask and rammed up altogether by hand.

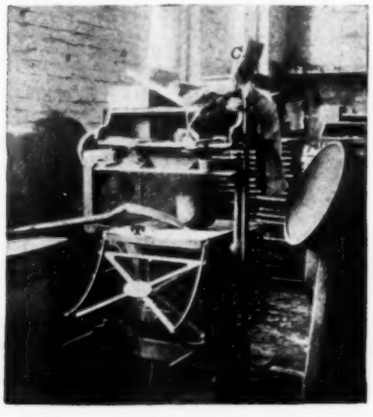

Fig. 1. SAND-PRESSING MACHINE.

Fig. 1 is from the foundry of the Racine Hardware Company, Racine, Wis. The table *T* is supported on four quadrants, cast in pairs; one pair pivoted at the centers of the arcs to each corner of the table, and the arcs of the quadrants traveling on straight supporting rails beneath—this arrangement of the table-pivoted quadrants and rails being such that the table can be pulled out in front of the overhead platen, or pushed in under the platen to the position shown in Fig. 1, very easily, the table standing always at the same level. This picture was taken in a "day off," when the molder was not at work. His apron is flung over the top of the machine; his riddle hangs at the side, in easy reach of the right hand; his shovel and swab pot are on the table, a follow-board, partly supported on the box of parting sand, lies on the top board of the machine; while his cap *C* hangs on the top end of a long vertical lever, so connected with the cross-beam cast in one piece with the supporting rails on which the table quadrants rock, that by turning the lever down and to the front the table will be strongly lifted towards the overhead platen. This is a simple machine, old and well known. To use this machine, the table is pulled out in front; the "match" and pattern are placed on it; half the snap flask is put on the match; a shovelful of sand is riddled over the patterns, and possibly tucked in with the fingers in some places; the flask is shoveled full of sand, rounded up, and the table and flask are then pushed in under the platen and the lever is pulled down, pressing the sand evenly into the flask. Then the table is pulled out, the flask is "straked" off and turned over on the table, and the match is lifted off, leaving the patterns in the sand in the snap frame. The lift is, of course, perfectly clean, as the patterns and match in this sort of work are made for rapid production and no expense is spared on anything. Then the other half of the snap is put in place, the sprue and riser plugs are located on the runner, and the cope is filled with the riddle and shovel, and rammed by machine pressure, as before; the sprue and riser plugs being so short as to stand a little below the top of the snap frame or flask. The mold is completed in the usual manner; the patterns, generally in one piece with the gates and runner, being drawn by hand, brushed off and laid back in the match. In this case the only office of the machine is to press the sand in the flask when the lever is turned down, and to provide means by which the mold can be moved quickly and easily under the platen and out into the open again, where the molder can work easily and freely.

In the other class of molding machines it is the pattern, not the sand, which is handled by the machine, and two machines and two patterns are required for each piece molded if the two sides of the piece are different. If the two sides of the piece are exactly alike, as in case of a pulley, then only one machine need be used to make both the cope and the drag or nowell, the nowell being made first and set on the floor, and the cope next, and closed on the nowell after finishing, same as with hand-made molds.

The engravings, Figs. 2, 3, 4 and 5, show the reaper-frame molding machines used in the foundry of the Milwaukee Harvester Company, G. H. Schulte, superintendent, Milwaukee, Wis. This foundry has 123 names on the pay roll as piece-work molders; 10 are apprentices. The highest weekly pay is about $21, and the lowest about $12, for the piece-workers who are full hands. There is very little changing of workmen; the job is steady, the floor is comfortable; and although the men are very busy indeed, there were no apparent signs of over-exertion. The floors, where the molds are too heavy to be easily handled by one man, are covered by overhead air hoists on light traveling

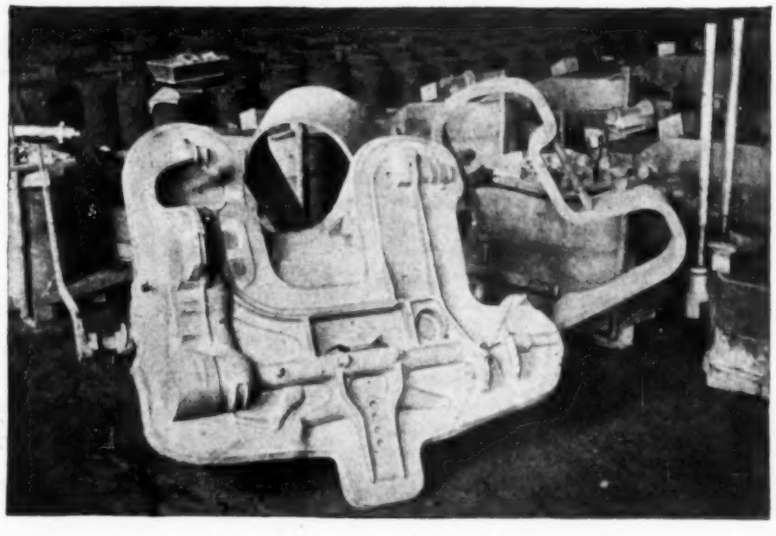

Fig. 2. REAPER-FRAME MOLDING MACHINE.

cranes, and all the lifting and tugging is done by air pressure. There are 6 lifts, from 4-inch to 6-inch cylinders; these were supplied by the Whiting Foundry Engineering Company, of Harvey, Ill.; the 6-inch lifts will handle about 1,500 pounds easily. The air compressor which

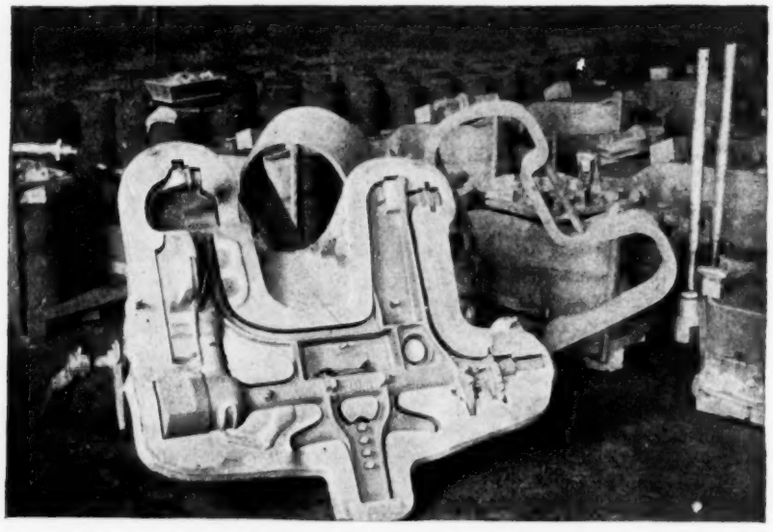

Fig. 3. REAPER-FRAME MOLDING MACHINE.

serves these lifts was built by Clayton, of Brooklyn, and the total cost of the air plant, compressor, lifts, overhead cranes and all was about $1,000.

Molding machines of the second sort, which handle the pattern, consist essentially of three parts: First, the pattern itself, which is, on the upper side, a duplication of one side of the piece to be made. Second, the frame of the machine, which has sides and feet to support the top and inclose the pattern-handling rock-shafts and rods; the top of this frame forms the draw-plate, and is cut to exactly fit the outline of the pattern. The third general division, the pattern-handling mechanism, is so arranged that, by turning a lever connected to one of the rock-shafts inside of the frame, the pattern will either be projected upward so as to stand above the draw plate, the surface of the draw-plate being the parting line of the cope and nowell, or turning the lever in the other direction will draw the pattern down into the frame of the molding machine; so that the pattern is either wholly below the surface of the draw-plate, or so far withdrawn from the sand as to be well clear from it everywhere. In either case the air hoist can be hooked on to the flask trunnions and the flask lifted freely from the molding machine, the drawing of the pattern being done entirely by moving the hand lever as described.

Fig. 5 shows the nowell machine and the half of the flask for making the nowell mold, in working position. The flask is open, without cross-bars; and after the flask is filled and rammed, the machine, flask and all are lifted in a wide bail hooked on the machine trunnions, rolled over in the air with the follow-board clamped on top, and set down in its place in the pouring row. Then the lever is turned and the pattern is drawn, the follow-board clamps are released, and the air hoist picks the molding machine off the completed nowell; the machine is rolled over in the hoist bail, and set down on its four short feet at the sand heap, ready to make another nowell. Fig. 2 shows this nowell machine turned up to the light to be photographed, with the pattern above the draw-plate. Fig. 3 is the same with the pattern drawn in by turning the hand lever.

Fig. 4 shows the cope-making molding machine for this same frame. In this case the pattern-handling rock-shafts are not covered by the frame of the machine, and the machine is mounted on wheels to be moved by hand along the foundry floor as it follows the diminishing sand heap. The cope flasks are thickly bridged, made of gray iron, of course, and shaped to closely follow the outline of the sand needed to cover the casting. The cope flask is put on top of the machine, located by the usual dowell pins, filled and rammed up with runner and riser plugs, lifted off with the air hoist and closed on the cope, all in an incredibly short space of time. The pictures were taken in the noon hour, as there was no point in the operation of molding which gave good views of the machines. These machines probably cost a good deal of money; they are elegant examples of metal work, highly finished, and beautifully smooth in action.

Mr. Schulte very kindly had a search made in the cost books, and found the average saving in per ton labor cost by the introduction of the air hoist and molding machines to have been not much less than 66 per cent. all round, the pay of the hands being rather higher at the lowest per ton molding cost. A note which I find in my book says that the reduction due to machines and hoists was from $6.60 to $2.40 per ton for total floor expenses, in case of one piece of work.

Fig. 6 shows an air-hoist cylinder fixed horizontally to the ceiling of the paint room of the Milwaukee Harvester Shops, and in use handling ground wheels in and out of the paint vat.

Whenever pieces of sufficient size to make the flasks not very easily handled are molded, there can be no question as to the economy of the air hoist; the molding machine, in one form or the other, can be employed in all cases of extended duplication of castings, and the cost reduction made by Mr. Schulte for the Milwaukee Harvester Company can be made in other shops by other superintendents.

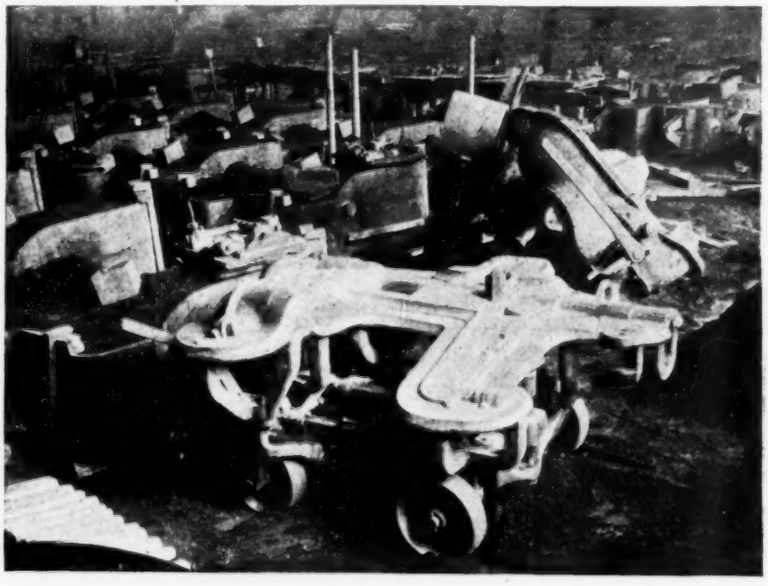

Fig. 4. REAPER-FRAME MOLDING MACHINE.

Experimental Data to Six Places of Decimals.

The following extract from a lecture of Prof. A. B. W. Kennedy, before the Institution of Civil Engineers, London, contains so much wisdom regarding over-refinement in deductions from experiments, that we give it a place in our columns. Professor Kennedy's comparison of American with European experimenters may or may not be just; but there can be no doubt that many of the deductions which are being constantly published in the transactions of our engineering societies and elsewhere, simply make their authors ridiculous:

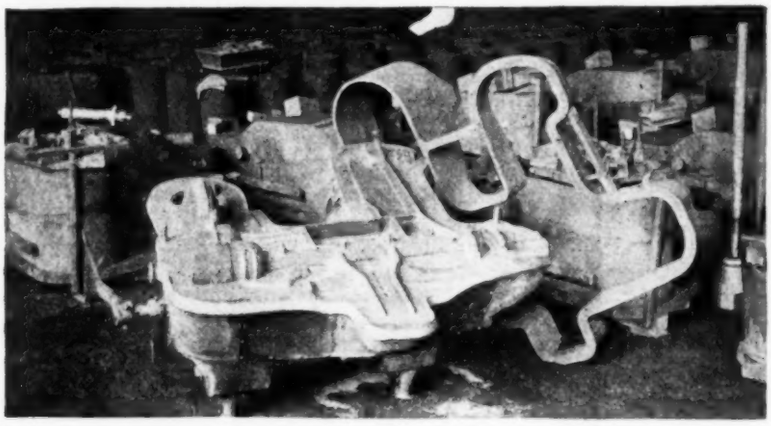

Fig. 5. MOLDING MACHINE AND NOWELL FLASK.

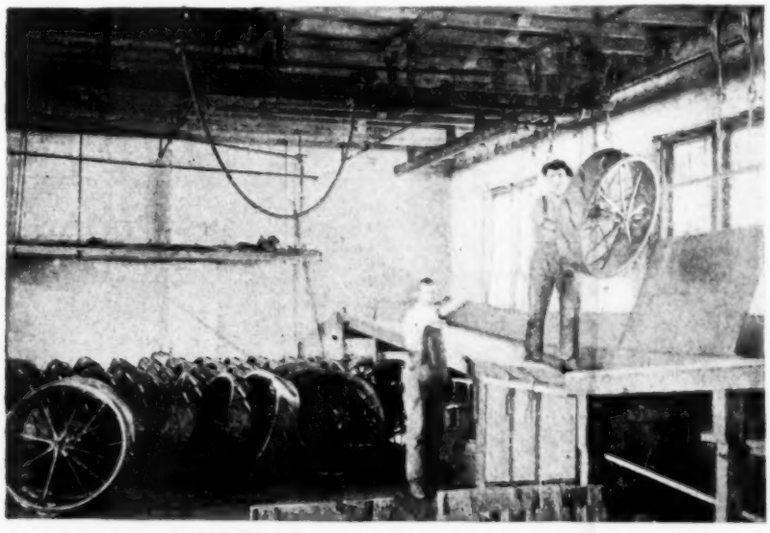

Fig. 6. PAINTING GROUND WHEELS WITH AIR HOIST.

"As the experimenter cannot for a moment pretend, and should not for a moment delude himself into supposing, that his results could be more accurate than his data, it is his first duty in this line of work to find out within what limits of accuracy his experiment can be carried out, and, when he has obtained his results, to state it only within these limits. Under these conditions the statement of a result in round figures is often much more accurate than its statement down to the last decimal place which appears in the arithmetic. I have heard it said by some of the students of the greatest of our physicists, Lord Kelvin, that this was a point upon which, even in a great deal of purely physical work, their master always insisted most strongly. But I am afraid that it must be admitted, as a weakness of much of our engineering experimentation, that its results are given in figures which are absolutely ludicrous as indicating the value of the quantities actually measured. In these matters, perhaps, our friends in America are even worse than we are, and those of us who have anything to do with steam vessels or with steamship trials, are perhaps the worst sinners. I suppose no physical problem could very well be much more complicated than that (I ought rather to say those) involved in the carrying out of a marine engine trial at sea, especially when power and speed are both concerned. When it is considered that the final result depends on the accuracy of our knowledge of the dimensions of the steam engine itself, and of the steam engine indicators, on the uniformity of elasticity and proper scale of the indicator springs, the accuracy with which the revolutions are observed, the accuracy of timing on the mile and of observing the distance at the same time, to say nothing of the assumption that the indicators themselves and their gear, unlike every other thing in the universe, are entirely devoid of hysteresis, it will be seen how entirely out of the question it is that the figures obtained, even for a single run in one direction, should admit of statement in, say, more than three figures. When to this is added the uncertainty of the method of averaging speed as between a number of runs under different conditions as to tide and wind, the matter becomes still more striking. Or when coal and water are also to be measured, and the weighing or measuring of both, and the calibration of all the heavy apparatus used for the purpose, as well as the personal errors due to making observations of large quantities under awkward physical conditions, in a minimum of time and in the worst of atmospheres, are considered, the uselessness, and, indeed, the absolute inaccuracy of extremely minute figures become absolutely glaring. It is sometimes useful, no doubt, under these conditions, to work out results to four significant figures for the sake of mere arithmetical checking; but no one who has had anything to do with the matter would suppose for a moment that more than three figures were of the least importance, and the statement of results of observations in five or six figures merely causes the enemy to scoff. Let me again say here that I am not suggesting, and I do not think that an experiment of a technical nature is unscientific because its result is only capable of expression within one or two per cent. instead of within one or two hundredths per cent. I wish only to urge very strongly that in a really scientific spirit such an experiment must be undertaken only with a distinct recognition of its limitations, and of the limitations of accuracy of result such as I have roughly indicated."

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By recent enactment of the Massachusetts Legislature, twenty new free scholarships in the Worcester Polytechnic Institute become available to the next entering class. This makes forty free scholarships now available, being one for every Senatorial district in the State, in addition to the twenty-five or thirty free scholarships to which students from Worcester County only are eligible.

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A visitor, somewhat familiar with pumping machinery, looked into the pump room of a certain water-works one day, and after looking around a little he remarked to the engineer that he was surprised to see nowhere a drop of water, and that even the water end, which in most pumps drips with perspiration, was also dry. "Well, you see," replied the engineer, "she does her work so easy, she don't have to sweat."

Piston Valves—II.

BY W. H. BOOTH.

Having obtained some idea of the plain piston valve, we may now pass on to a consideration of the automatic, variable cut-off piston valve. In doing this I will describe the valve, and content myself with a description of one means of using it as a variable cut-off. There are so many ways of accomplishing the same end in mechanics that probably every reader will see for himself how he can, for his own purposes, improve on the means shown, which, I must premise, are means that have been adopted with comparatively slowly moving engines.

In a variable cut-off valve there are two means of varying the cut-off. One of these is the putting forward of the eccentric so as to give an earlier closing movement to a valve. Another is the addition of outside lap, which is effected in the well-known Meyer gear by having the valve made up of two plates and connecting them by a right and left screw, so that by revolving the screw the valve plates become more separated, which is the equivalent of additional lap. The same effect is secured by varying the travel, as is done in the link motion.

The variable cut-off by the piston valve is effected in two ways—the cut-off by a sudden addition of lap to the full extent of the widest steam-port opening, and the angular variation of the movement which puts on the lap so as to change the time of the addition relative to the crank position.

In Fig. 5 the piston valve itself is shown in section. It is simply the ordinary plug valve, already described, to which have been added several projecting pieces the sum of which occupy something more than half the circumference.

In Fig. 6 we have the valve in its seating. Fig. 6 also represents the valve in its extreme position for taking steam; and it will be apparent that, by revolving the valve upon its axis a distance equal to half the pitch of the wings—which, in an eight-port valve, will be through an angle of 22½ degrees—there will be caused a sudden addition of lap to the extent *a*. In other words, the ports in the shell will be entirely closed simply by a movement of the valve of 22½ degrees. If we suppose the two shells at opposite ends of the cylinder to be fixed in place so that their ports are in the same longitudinal lines, and that the valves are fixed on the valve spindle so that the wings of one valve are opposite the gaps of the other, then it will be obvious that the cut-off movement for the head end of the cylinder will place the valve of the back end in its position of no lap, and, in turn, the cut-off movement for the back end will place the valve in position again to give steam at the head end. The valves then oscillate to and fro through the angle of 22½ degrees, or one-sixteenth of a circle for every revolution of the engine, and the time of this movement is altered to suit the ratio of expansion required. A little thought will show that the steam will be cut off altogether if this movement take place early enough; and there is nothing to prevent this. Indeed, this form of valve can be very well used to stop an engine.

A great advantage of the movement is that the exhaust alone need be considered when designing a valve gear, for steam can be carried nearly the full length of the stroke of the valve itself, as a plain valve. In fact, the longitudinal movement is quite distinct from the axial rotation, and a valve is simply designed as though it were a plain locomotive slide, carrying steam seven-eighths of the stroke, and the axial rotation is superadded. One valve does

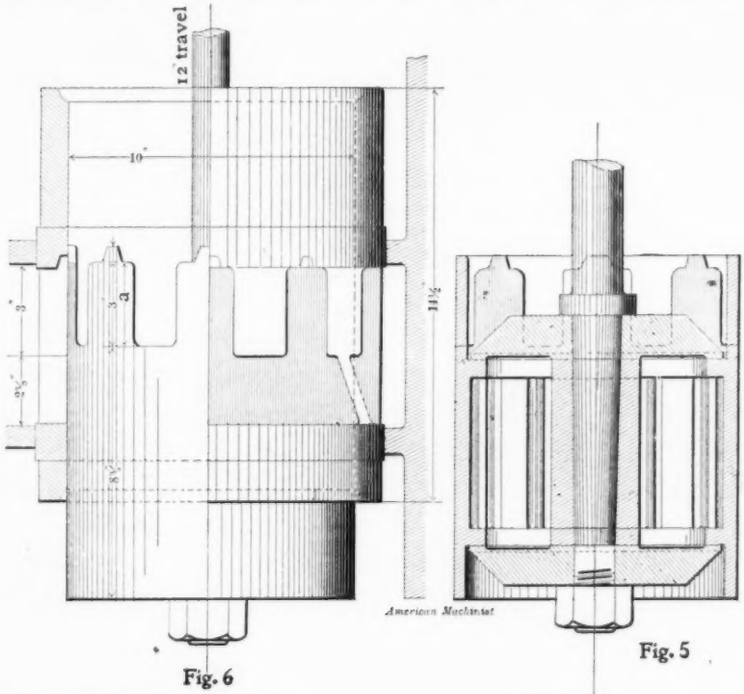

Fig. 6

PISTON VALVE AND SHELL.

Fig. 5

duty for steam, exhaust and expansion. The rotation of the valve spindle is effected by means of a lever fitting upon an enlarged and squared portion of the spindle, preferably at some point between the two valves, in order to ease the stresses in the spindle. The squared spindle slides easily through the squared hole in the lever, and the lever is held from any movement in the same direction by the bracket in which it works.

The angular movement of the lever is given by means of a swinging or sliding frame which carries a pair of friction rollers, and these are acted upon by a quick-action cam, as in Fig. 7. This cam revolves at the same speed as the engine itself, and is driven from the engine shaft by gears; but there is interposed in the middle of the cam shaft a differential gear of the type used in the Roving frame of the cotton mills, and known as "Holdsworth's differential gear." It is sometimes called a "Jack-in-the-Box," and consists simply of a bevel wheel on one end of the shaft, driving another bevel wheel on the end of the divided shaft, through the intermediary of one or more bevel wheels carried in a frame. The first result is that the two ends of the divided cam shaft will revolve in opposite directions. This is of no moment to us. But the frame carrying the intermediate wheels is a wheel, and can be revolved; and in any movement thus given to it, it carries the intermediary bevels round with it, and changes the relative angular motion of the two halves of the cam shaft.

As the frame is turned backwards or forwards, so are the two parts of the shaft *t t* turned through an angle relative to each other of just twice the angular movement of the frame. Thus, by moving the frame through an angle of 5 degrees the cut-off cam is moved 10 degrees. The frame wheel may have teeth cut on its periphery and be driven by a worm; the worm may be driven by the engine governor, and a common type of gear for this purpose is that of Fig. 9, where a pair of friction cones *a* and *b*, upon the governor spindle, drive a third cone *c*, which drives the differential gear.

In the illustrations, Fig. 7, the valve spindles are shown coupled to the short

piece of square bar, which slides through the square eye of the lever *l*, that swings in an angle of 22½ degrees in a bearer bracket *b*. A rod *n* connects the lever *l* with a swinging or sliding frame, which carries the friction rollers *s s*. In the figure, the frame hangs from a pivot *p*, and, properly speaking, the cam *k* ought to be designed with an allowance for this fact, not needed when a sliding frame is employed. The cam *k* is carried on the shaft, which is driven by the differential gear shown in Fig. 8. In Fig. 6 the valve is shown in its extreme position for taking steam. When in full exhaust travel, the exhaust end of the valve travels completely over the shell ports, and uncovers for exhaust both the wide and narrow openings in the shell, so providing the necessary greater exhaust-port area.

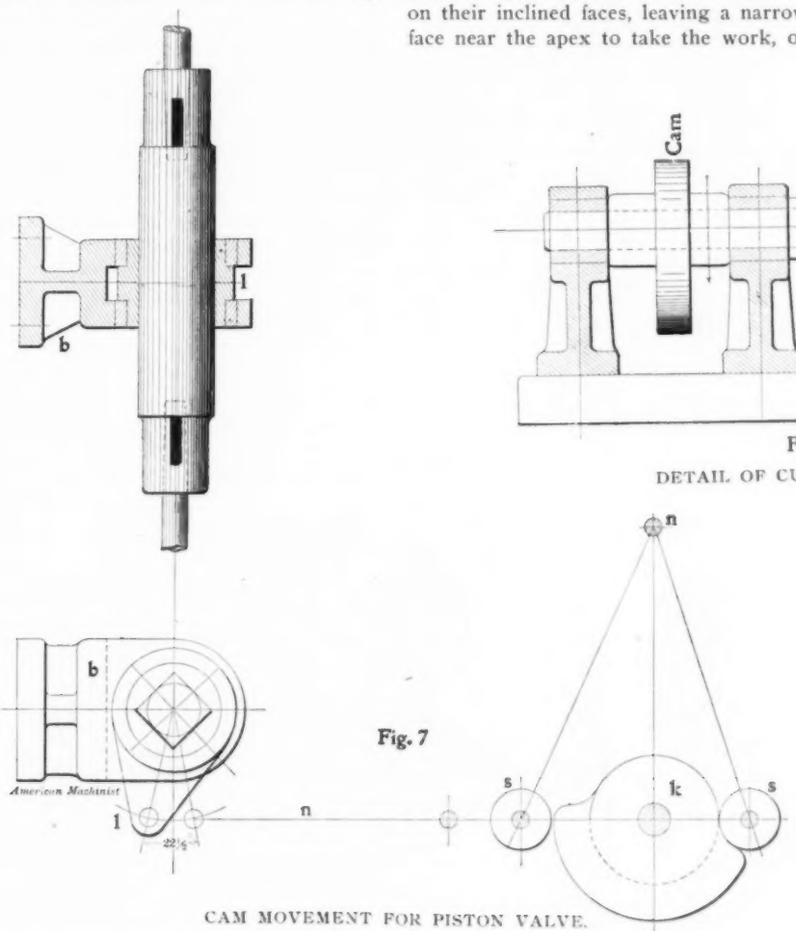

Fig. 7

CAM MOVEMENT FOR PISTON VALVE.

This particular valve was designed for 12-inch travel; and as the figures are reduced in the same ratio as the scale, the extreme exhaust position can be laid off as 12 inches from the extreme position shown in Fig. 6. Possibly in practice it might be desirable to lengthen the shell, especially at the steam end, in order that simply the wings should travel outside the shell at this end, and at the exhaust end there should be only a projection of the valve of, say, 1 inch.

As there is very little wear in a good piston valve, there is not much movement outwards of the V-block whose duty is largely to act as a stop against leakage; but it is obvious that a V-block, if it fits when the valve is new, cannot be a fit when the valve is at all expanded. It is therefore good practice to back them off on their inclined faces, leaving a narrow face near the apex to take the work, or otherwise there is the tendency for contact to occur only near the base; and the apex being outside the protection of the valve ends, steam would leak along the point of the wedge.

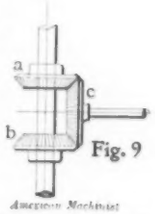

Fig. 9

DRIVING GEAR.

In Fig. 10 the shell interior is shown as though rolled out flat, and the wings of the valve are shown in their cutting-off position, covering the steam ports of the shell. It will be seen that a cover of about ⅜ inch is allowed all round the port. The rapidity with which the variation of cut-off is effected depends entirely on the speed of the governor and the ratio of the train of gears between it and the differential gear. In old arrangements there was very great reduction and the variation was very slow. Any sudden change of load was provided for by a throttle valve, and the expansion gear gradually brought back the engine to normal speed, and the throttle valve to normal opening. For factory engines, with a steady, uniform load, this is a good system. It will be clear that, with the arrangement of governor gear shown in Fig. 9, the expansion will continue to vary until the engine is brought to normal speed, and neither of the bevels *a* or *b* presses upon *c*.

It is here that the Corliss valve gear fails. To cut off earlier with a Corliss gear, demands that the engine shall run faster, and vice versa. Hence it is that the supplementary governor is added whose duty it is to vary the length of the cut-off rod and bring the engine to normal speed. With the piston-valve gear I have sketched out, this is done with the one governor, but at a sacrifice of rapidity of action. There is no difficulty in applying a trip gear to the piston valve and securing the rapid variation, as in the other trip gears. In that case the two valves would perhaps be best, if independent and tripped separately, so as to avoid the double wear and tear of both tripping at each stroke.

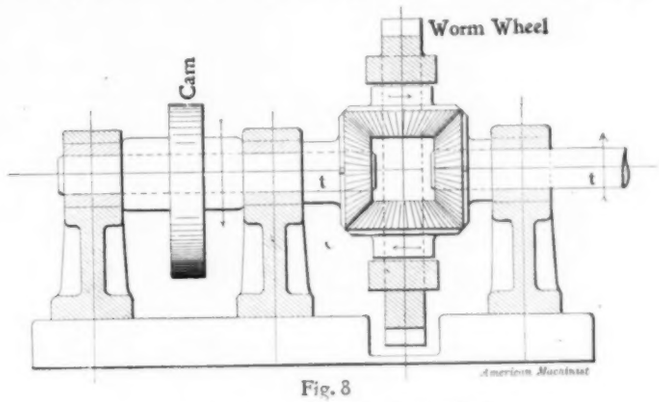

Fig. 8

DETAIL OF CUT-OFF MOVEMENT.

The cam motion is good enough for moderate speeds, and I do not see why the differential gear should not be arranged to take a quick change in position for variable expansion; but a quick engine needs a trip gear, as there would probably be a considerable shock with the cam. The disadvantage of the piston valve, as a trip valve, is possibly its larger radius, for it cannot conveniently be made long and of small diameter, like the Corliss valve, but its many ports allow of a

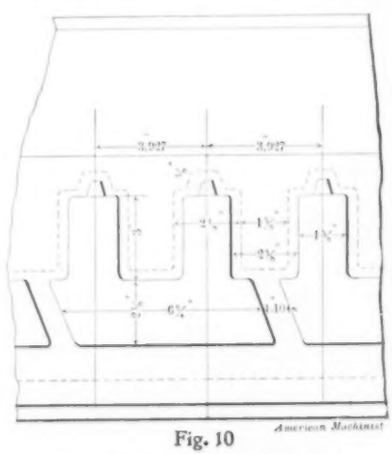

Fig. 10

PISTON VALVE PARTITIONS.

very small rotation angle; and this is a good point, as also is the absolute freedom from steam pressure. There is, of course, no special virtue in the number of ports being eight. Old designs only show four cut-off wings, and ten have been tried, while for large valves even more than ten might be used, in order to reduce the angle of twist and the shock of bringing to rest the rotating valve. But a multiplicity of ports implies a greater proportion of cover, and there should not be a needless number.

The reason for the longevity of this type of valve is the combined longitudinal and axial movements, which assist to prevent scoring and to maintain circularity. Still better results would be attained by arranging that the axial movement was continuous, or always in one direction. I set out with these descriptions, however, in part as a reply to inquiries made of me respecting my previous communication on Piston Valves, wherein I stated that success could be only attained by adopting the continuous surface principle and avoiding the working together of two discontinuous surfaces. The type of valve I have described is plainly one of broad, single surfaces. The cut-off projections, it is true, are parts with distinct edges, that are called on to pass across the port edges in the shell, but these cut-off wings are short and stiff, and are parts of the continuous body of the valve itself, and so are afforded strong support. The valve receives its twisting motion often when the steam port is not fully open, and there is thus very little unsupported length of wing. There is nothing approaching to the nature of the narrow, loose packing rings of the ordinary type of piston valve. What is wanted is that someone should adapt this piston valve to small automatic engines. I believe it is to be done, though probably the adaptation will bear little resemblance to my sketches herewith. Whoever succeeds in doing this, however, will, I feel sure, reap a great benefit and produce an engine that will find a good market. The timidity which fears great wear in piston valves, and therefore equips them with spring rings, to their own undoing, does not realize how the very principle of the balanced piston itself removes the great cause of valve wear, and that, if provided with some initial powers of expansion a valve may be worked for a long time and remain steam-tight, for the combined movement gives to these working faces a smoothness and polish unequaled in any other valve.

London, Eng.

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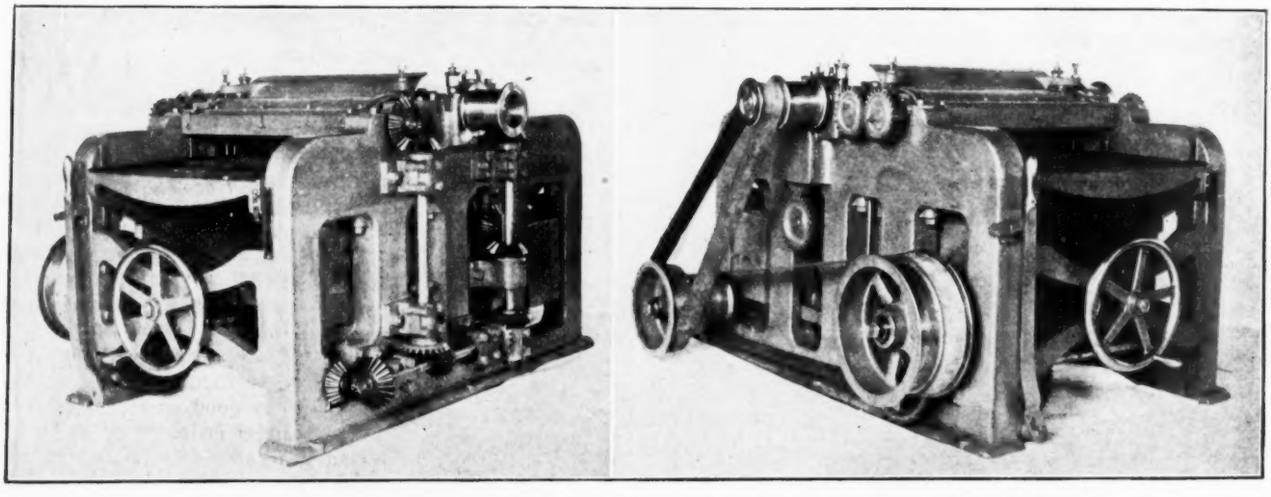
An Improved Surfacing Machine.

The two half-tones herewith show a new surfacing machine designed by Mr. C. G. Taylor, superintendent of the shops of the University of Michigan, and built at that institution by the students and skilled workmen employed there. The machine is designed especially for furniture or pattern shops, or where smooth work with a minimum of hand labor is required. It is at the same time capable of doing heavy work rapidly. It will take stock from 1-16 inch to 6 inches in thickness by 30 inches in width.



SURFACING MACHINE BUILT AT THE SHOPS OF THE UNIVERSITY OF MICHIGAN.

The "cylinder" is a steel forging 4 inches square, and may be used with either two or four knives. It has steel lips for knotty or cross-grained lumber, and runs in long, heavy bearings. The pulleys, at each end, are 5-inch diameter by 5-inch face, and are intended to run at 3,800 revolutions per minute. Gravity pressure bars, one before and one behind the cylinder, are adjusted to work automatically with the rolls, and to be at a constant distance from the cylinder. They hold the work firmly to the bed, preventing gouging of the ends, and allowing very short pieces to be surfaced. An adjustable bar in front of the first feed bar is set according to the material, and prevents the operator from taking unreasonable cuts and overstraining the belts.

The bed rests on four 30 degree wedges, and they run on horizontal ways cast to the frame. The wedges are connected in pairs by beams crossing the machine. The bed is raised and lowered by a right and left screw on the hand-wheel shaft through the center of the machine. The wedges are adjustable to keep the bed parallel with the cylinder and out of wind.

The work is driven by four 4-inch rolls, the front upper roll being grooved and running in ball-and-socket bearings that allow a play up and down of ¾ inch, weights within the frame regulating the pressure. The upper roll at the back requires little motion and is held against the work by heavy pieces of rubber. The rolls respond promptly, no matter how the work enters.

The feed mechanism is driven by bevel gears on the right side of the machine, and by spur gears on the left side, all being cut gears—a refinement not common with wood-working machinery. The positive or gear feed is 30 to 1, and the belt part is 6 to 1 for slow work and 4 to 1 for fast work. The cylinder makes either 180 or 120 turns for one of the feed roll, the speed of the work being 20 or 30 feet per minute. The feed is under the complete control of the operator.

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The coming summer is to see a revival of the railroad races from London to Scotland. The North Eastern Railway Company has completed five new engines for this special service. The cylinders are 20 x 26 inches; the four coupled wheels are 7 feet 7¼ inches diameter and 9 feet 6 inches apart. The boiler is 4 feet 4 inches diameter and 11 feet long. The firebox is 7 feet long and the center of the boiler is over 8 feet above the rails. The engine and boiler together weigh 90 gross tons. On a trial trip no difficulty was experienced in maintaining a speed of 70 miles per hour.

Hydraulic Reversing Gear for Rolling-Mill Engines.

The extent to which rolling-mill engineers make use of hydraulic pressure, can only be realized by personal inspection of rolling-mill work. We illustrate herewith an interesting application to the reversing gear of a blooming-mill engine at the Pencoyd Iron Works.

The engine is fitted with a Marshall valve gear, shown in Fig. 1, in which *a* is the engine shaft carrying the eccentric—one eccentric operating with this gear to drive the engine in both directions. The usual eccentric rod is replaced by a beam having great vertical stiffness, as with this gear it is the vertical and not the horizontal movement of the beam which actuates the valve. Attached to the reverse shaft, in the center line of the engine, is

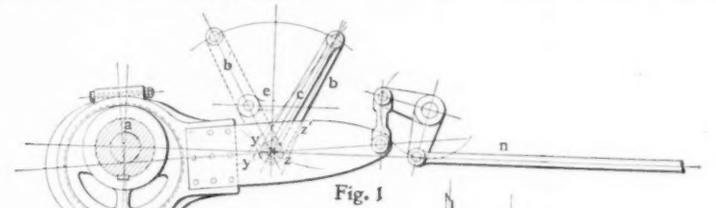

Fig. 1

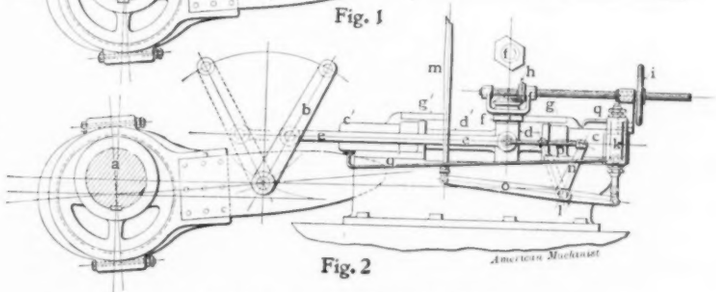

Fig. 2

HYDRAULIC REVERSING GEAR.

an arm, shown in two positions, $b\ b^1$. From the upper end of this arm is swung the hanger link *c*, from the lower end of which the eccentric beam is hung. The hanger link is of the same length as the rock-shaft arm, its lower end and the attached pin of the eccentric beam swinging through the arc $y\ z$, when the rock-shaft arm occupies the position *b*. When the rock shaft is turned to position b^1, the arc of oscillation becomes $y^1\ z^1$, and this change in the position of the rock-shaft arm so modifies the motion of the valve through the change in the vertical motion of the eccentric beam as to reverse the motion of the engine. The valve stem *n* is driven from the outer end of the eccentric beam by the bell crank and short link clearly shown. The change in the position of the rock-shaft arm is effected through the rod *e*, which is connected at its outer end to the hydraulic reversing gear. It should be remarked that the effect of throwing the rock-shaft arm to different positions is to vary the point of cut-off very much after the manner of a link motion. The positions shown in Fig. 1 are for the full gear, giving a cut-off of $\frac{7}{10}$ of the stroke.

The hydraulic cylinders with their attachments are shown in Fig. 2, in which, for greater clearness, the valve connections beyond the end of the eccentric beam are omitted. At $c\ c^1$ are the hydraulic cylinders with the rams $d\ d^1$ in one piece. At $e\ e$ is the connecting link between the rams and swinging arm *b*. The rams carry a stop plate *f*, which moves between the stop bars $g\ g^1$, and has its motion limited by them. This stop plate *f* is of irregular hexagonal shape, as shown in the plan view, and the extent of its movement is determined by the pair of faces which are presented to the stop bars $g\ g^1$. The plate is revolved by means of the bevel gears *h*, splined shaft and hand wheel *i*; and by presenting different faces to the stop bars $g\ g^1$, the movement of the rams and extreme point of cut-off are limited. In the present engine, these extreme points of cut-off are $\frac{5}{10}$, $\frac{6}{10}$ and $\frac{7}{10}$ of the stroke. At *k* is the valve for controlling the admission and discharge of the pressure water to and from the hydraulic cylinders—the connecting pipes being shown at $q\ q^1$. This valve is operated by the lever *o* and rod *m*, which extends upward to the engineer's platform. The valve has also a compound movement, derived from the link *p* and lever *n*, which latter carries an eccentric pin *l*, by which its movement causes a vertical movement of the lever *o*. The effect of this connection is that after the valve *k* has been moved in either direction by the rod *m*, the resulting movement of the rams at once moves the valve in the reverse direction and closes the port which has been opened by the initial movement of the rod *m*. The result is that a slight movement of the rod *m* is followed by a correspondingly slight movement of the rams, when the valve is closed and the movement of the rams ceases. Further movement of the rod is followed by further movement of the rams, and so on. In other words, each position taken by the rod or its hand lever is followed by the rams and rock shaft *b* taking a corresponding position, precisely as though they were positively connected together. The result is that the cut-off is set and held at any point determined by the hand lever, up to the limit determined by the adjustment of the stop plate *f*.

The engine to which this gear is applied is the two-cylinder 40 x 60 whose hydraulic governor was shown and described in our issue of April 23d. In an engine of this size the handling of the reverse gear by direct manual power would, of course, be scarcely feasible. The two articles furnish excellent illustrations of the facility with which hydraulic pressure is applied to different uses in rolling mills. We are fully persuaded that it could be put to an equally varied and useful number of applications in other fields of work.

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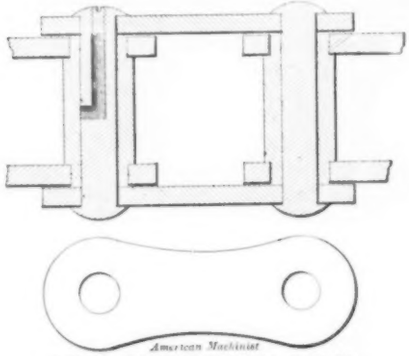
Steel Transmission Chain.

The subject of Chain Transmission, stimulated somewhat perhaps by the use of chains on bicycles, is attracting increased attention, and we give on this page a section of a chain which is designed especially for use, not on bicycles, but with other machinery where cut sprockets are used, and where durability and smooth running are important.

The inside links are fastened to a sleeve which has a reamed hole through it, to which is fitted the pin that is riveted to the outside links, and thus the bearing is a long one; and, when the speed is high, or for any reason it seems desirable, each rivet is drilled for oil, as shown at the left; and in some cases the central hole is carried nearly through the pin, so as to form a larger reservoir for oil. Thus made of steel, the chain is very durable, and in many cases seems best fitted for positive



STEEL TRANSMISSION CHAIN.

transmission of motion from one part of a machine to another.

It is made by the Boston Gear Works, 35 Hartford street, Boston, Mass.

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The Placing of Lathes in a Shop.

Editor American Machinist:

I would like to ask the trade, through your paper, for an expression of opinion on the following:

It is desired to set up a single row of engine lathes on one side of a room. Should they be arranged so that the workman will be between the lathe and window, or the lathe between the workman and window? NOVICE.

ELECTRICAL MACHINERY.

How to Insulate Grooved Armatures.

BY WM. BAXTER, JR.

In an article contributed by the writer to this journal, on the relative merits of smooth and grooved armatures, it was stated that some manufacturers did not use the latter type, owing to the difficulties encountered in properly insulating them. It was also stated that if the requirements were properly understood, and the weak points properly protected, the insulation could be made just as substantial and permanent with the grooved type as with the smooth core, and without any material increase in cost of construction. It is proposed in this article to demonstrate the truth of these statements, to point out the most likely places for trouble to occur, and to show how to guard against them in an effectual and inexpensive manner.

The subject can be clearly explained by

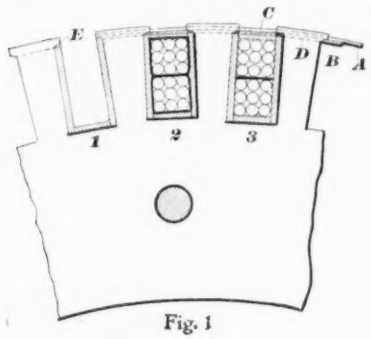

Fig. 1

the aid of Figs. 1, 2 and 3. Fig. 1 shows a section of a grooved ring armature, on a plane at right angles to the axis of the shaft. There are three grooves shown. No. 1 is empty, and simply shows the insulation on the sides and bottom. No. 2 is filled with separable coils, and No. 3 with wire wound in place. Starting with No. 1, it may be said that the most perfect way to insulate the sides and bottom is by using a trough or U-shaped piece that will just fit into the groove and is of the proper thickness. It should be made of mica for any machine that is calculated to work under an electromotive force of over 110 volts; but sheet fiber boiled in paraffine, so as to render it moisture proof, will answer very well for much higher voltage if the machine is to be used inside a building. The trough can be made of mica by splitting it into very thin sheets, so that they will bend around the corners without cracking. These can be stuck together, until the required thickness is obtained, by using copal varnish with a small amount of raw linseed oil, to keep it from getting brittle; the whole being thinned down with turpentine to the proper consistency. Troughs of this kind are made by a concern engaged in the business of manufacturing sheet mica insulation for all purposes, and the work they turn out is far more mechanical than anything that can be made by hand, but it is expensive.

An insulation that is almost as perfect as a solid trough, and which will give just as good results in actual service, can be made by lining the sides of the groove with strips of mica of the proper width and built up to the proper thickness. These should be stuck together with varnish, and be pressed against the iron by forcing a hardwood strip into the groove. This strip should be as wide as the finished groove is required to be. The side insulation should reach to the bottom of the groove, and should be stuck firmly against the iron tooth. After the varnish has dried, the strip of wood must be taken out and the bottom insulation put in. This should be made of strips of mica fully as wide as the space between the side insulation. After the bottom is put in, the whole inside of the groove should be covered with a piece of linen stuck on with varnish. This is for the purpose of keeping the mica from breaking off in flakes while the wire is being put in place. The object of having the side insulation run down to the bottom is to obviate all possibility of leaving an open crack at the corners, through which the wire might be forced, and thus come in contact with the iron of the core.

If the armature is to be wound with separable coils, and these are arranged so that one-half fills the lower part of one groove, and the other half the upper part of another groove, it will be necessary to either lay a strip of fiber or mica, built up to the proper thickness, between the two coils, or else have an extra thickness added to the insulation of the under side of the half of the coil that fills the upper part of the groove. This is necessary from the fact that the difference of potential between the two coils in each groove is equal to the total electromotive force of the machine; that is, the whole electrical pressure of the machine is exerted between these coils, and if there is any weakness in the insulation it is very liable to break through. This extra insulation between the two coils is shown in groove No. 2, Fig. 1. Groove No. 3 is shown with the coils wound in place, and the insulation between the two is very light, because the difference of potential between them is small from the fact that they are successive coils; that is, their terminals connect with adjacent sections of the commutator.

To prevent the wire being thrown out of place by centrifugal force, when the armature is in motion, it is necessary that it should be held firmly in place. The most common way of doing this is by placing several bands of wire around the armature. These bands must be well insulated from the wire; if not, the armature could be short-circuited by the current jumping to the band at two different points. The bands should also be insulated from the teeth of the armature core. In order to make this part of the structure substantial, it is necessary that the grooves be deep enough to leave a considerable space between the top of the wire and the under side of the bands, say five or six hundredths of an inch. Grooves should also be turned in the face of the armature deeper than the diameter of the wire of which the bands are made plus the thickness of the insulation under them. This will protect the bands from injury should the armature strike against the pole pieces, which it is liable to do, on the under side, when the bearings wear down too far. Those portions of the wire that come under the bands should be covered by pieces of mica about four hundredths of an inch thick, and as wide as the space between the side insulation of the groove, and about half an inch longer than the width of the bands, so as to project about a quarter of an inch on each side. After these pieces are put in place, a mica band about two hundredths of an inch thick and one quarter of an inch wider than the wire band, should be put in the groove turned for the latter. The bottom of this groove in the teeth of the core should be lower than the top of the mica pieces laid on top of the wire coils, so that when the wire band is wound on, it will press on the coils and hold them tightly in place. The bands should be made of tinned steel wire and be soldered together throughout their entire length.

In Fig. 1, *A* shows the wire band, *B* the mica insulating band under it, *C* the mica strip on top of the coils and under the band. *D* shows the bottom of the groove in the teeth of the armature core, and this must be lower than the top of *C*, so that the pressure of the band *A* may hold the coils tightly in place.

Another way of holding the coils in place is to drive in from the end of the groove a dovetail shaped strip of hardwood, that will catch under the projections *E* of the teeth. When this arrangement is used, the side insulation should not be any higher than the top of the coils.

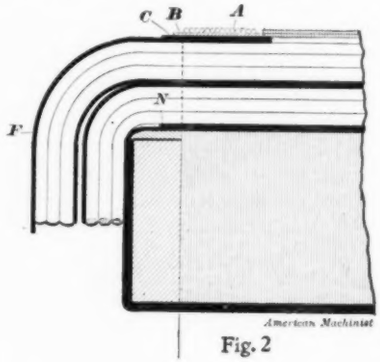

Fig. 2

The foregoing shows how to insulate the coils within the grooves. When they pass out and over the ends, there is some danger of the insulation giving away at the corner of the armature core. (See Fig. 2.) This is very apt to occur if the wire is wound in place. To prevent this, the end rings that clamp the armature core together should be made of a smaller diameter than the bottom of the grooves. This will leave room for a strong ring of mica, which should be held in place by a piece of heavy cloth lapping down over the end of the core. The mica insulation in the bottom of the groove should lap over onto this ring, as shown in the figure at *N*. At the top of Fig. 2 is shown in section one of the wire bands *A* of Fig. 1; also the canvas head *F*, and the manner in which it is held in place by the end band.

As space is not so valuable on the inside of the armature core, or on the ends, as it is within the grooves, there is no special difficulty about making the insulation perfect, as it can be made very much thicker, and furthermore, only has smooth surfaces to cover. If the wire is wound in separable coils, no insulation is required on the interior surface of the ring; but it is just as well to cover it with a thick canvas, well stuck on, so as to avoid the possibility of the current jumping through the accumulation of metallic dust in the course of time.

The point where there is the greatest danger of the insulation giving away is at the end of the groove. This will be better understood by looking at Fig. 3, which shows the surface of the armature. If the

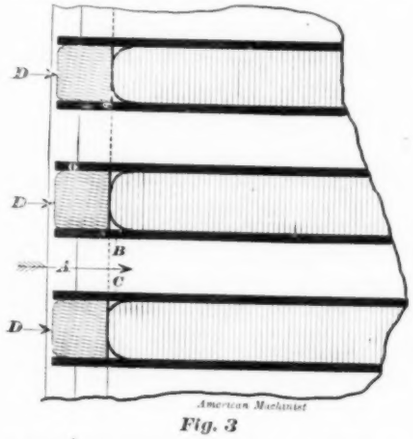

Fig. 3

wire in the groove, designated by the arrow marked *A*, should press hard to one side or the other, the sharp corners of the armature core teeth *B C* would tend to cut through the mica insulation. By filing these corners off, the danger can be largely reduced; but this alone is not a sure safeguard, because sometimes, through an accidental blow while in use, the pressure becomes very great and may be followed by a certain amount of grinding motion, which will gradually wear away the mica, even if the corner is rounded off. In order to make this point perfectly safe, it is necessary to insert a block of hardwood, soaked with oil, at the end of each tooth, as shown at *D*. These blocks are held in place by a piece of strong linen, which laps around them and into the groove, under the mica. With these blocks it is impossible for the insulation to give away at the corners *C* and *B*, because one block cannot move without moving all the others, as all the space around the circumference is filled up, either with wire and insulation or with blocks.

After the armature is round, the various parts of the insulation having been made according to the foregoing explanations, it should receive five or six coats of shellac varnish and be allowed to dry without the use of artificial heat.

As to the thickness of the insulation within the grooves, it may be said that, if made of mica and covered with linen, it may be as thin as three one hundredths of an inch for small machines—say four or five horse-power motors, and 230 volts or less. For larger machines and higher voltage it should be thicker, but not in proportion to the increase in size. For 500-volt machines of fifty to one hundred horse-power it should be from five to seven one hundredths, and run up to about ten one hundredths on very large generators.

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Letters from Practical Men.

Box-Frame Punch Presses.

Editor American Machinist:

We note in your issue of May 14 what Mr. Smith has to say in reply to Mr. Randol's criticism in your issue of April 23. It seems to us to be simply a question of the adaptation of the box frame to a particular line of goods. As to the use of the box form in machinery generally, probably no one will deny that America must yield precedence to Great Britain; but whether America or Great Britain, it was no new thing to machinery builders ten years ago. In the particular line of punching and stamping presses we have always used the box frame. If one compare such a machine with, for instance, the slotter, is there not a strong "family resemblance"? Yet the slotter with the box frame was no novelty ten years ago. While the superiority of the box frame is admitted by all up-to-date mechanics, it should scarcely be regarded as a novelty either at this time or ten years ago.

PHILADELPHIA TOOL MACHINE CO.

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Driving Ropes.

Editor American Machinist:

I am now more able to reply to "J. H. D." than when I wrote a few days ago.

How many ropes of a set will bed themselves? I have seen all do this, and I have seen two or three out of a set of eight to twelve that have rotated. There is no rule. The flattening of the rope sides will not, I think, cause any differential speed effect when driver and driven pulleys are of different diameter; but where some ropes rotate and others do not rotate, there must be a differential effect caused as between different ropes. I cannot give any results as to the extra durability of bedded ropes, because I am not in a position to watch any particular set of ropes for a sufficiently long time to come to a conclusion; but I can say that rotating ropes become fluffy on the surface more than other ropes, and it is obvious that when a rope is pressed in every direction it must become softer, exactly as an orange will lose its internal firmness more quickly when exposed to alternate and repeated pressure on two axes than to pressure on one axis continuously.

Exact alignment is correct and good, but only a few days ago I saw ropes which were running between pulleys of different groove pitches, and some of the grooves must, of course, have been not in true alignment; yet the worst-placed ropes were not rotating on themselves, and, as "J. H. D." states, it is a fact that ropes don't seem to pay any attention to slight lateral displacement, but they must, all the same, become more worn by the constant side friction they have to undergo.

As regards the continuous system, a good deal is made of so-called evenness of all the laps, but in practice it matters very little if one rope has a bigger sag than another. The slack side is always so slack that it is obvious the grip of a rope is very much a matter of groove grip, and not of slack side tension, and this objection fails therefore. With good splices, which ought to have a length of seventy-five or eighty diameters of the rope, a splice has so great a margin of strength that very little is seen of them. They can hardly be traced after some time of running. But the great advantage of the multiple-rope system lies in the fact that when a rope begins to fail—and this can be seen by undue fluffing—it will stretch and cease to do its fair share of duty, so that it does not soon break and can be cut off next stop, or, if necessary, in a minute's stoppage, and the remaining ropes go right along with the work. Not so with the continuous rope, which has one splice. The full load is always on the splice and there is no chance of relief, and breakage may occur and cause a stoppage at an awkward time.

I have very little experience of hemp ropes. I recently saw some work very satisfactorily, but they were not manilla and they were only of small size—1¼-inch; but hemp did not do well when first tried for heavy driving, and the reason seems to be the lack of pliableness and homogeneousness. In a cotton rope every thread is of the same size, and a rope, if honestly made, is even throughout. You cannot depend on a rope of manilla to be even throughout, however honestly made, because of the peculiar

roughness of the fibers individually. At the same time, I think that the popularity of cotton ropes is largely due to the fact that, as Lancashire is the leading county in the country and possesses by far the largest amount of steam power of any district, and the staple industry is cotton, there is a natural tendency to favor cotton ropes. Still, for all that, they are really the best, and have proved themselves so for many years in the smaller sizes of from $\frac{1}{16}$ inch for spindle bands, $\frac{3}{16}$ inch for card rollers, and $\frac{3}{4}$ inch or less for rim bands in driving the parts of cotton machinery. Can any one inform us if the small ropes in American cotton mills are of cotton or of other material? I mean the ropes—none larger than $\frac{3}{4}$ inch—which are run on cards, mules, or for spindle bands.

London. W. H. Booth.

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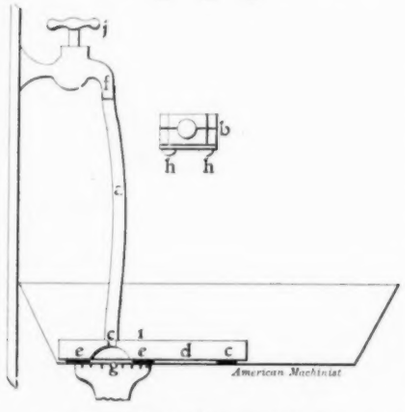

The Sink Stopped Up.

Editor American Machinist:

About a year ago, and at a time when I was very busy, my wife reported that one of the kitchen sinks was stopped up and a leaky tap was making things very uncomfortable. I at once sent for a plumber, and when he came, showed him that and another small job I wanted fixed; but, as plumbers have a queer way of making bills, I wanted to know the cost. His reply was that it was impossible to tell; it might take five minutes or two days; the whole waste pipe might have to come out. I replied that I could give no work without a price. He said he was busy and would call to-morrow. I would have given him $5 to put everything in good shape, so I said: "Very well, tell me to-morrow." I send you a sketch of what I made before breakfast next morning, that cost me nothing and was instantaneous in its operation. The kink may be of use to some of your numerous readers.

A piece of pine *d* 6 x 10 x 1½ inches: In the hole *e*, drive or screw a piece of pipe; tack cloth, rubber or leather washer *e e e*, strips of same; attach piece of ½-inch garden hose *a*, to nipple *e*, by wire or clamp; slip clamp *b*, made of wood, over hose *a*; push up over bib cock *f*; move up *b* over *f*, and screw up screws *h h*; place *d* so that *e* will be over center of sink grate *g*; with one hand press *d* hard at *i*, with the other turn on service *j*. You will have a poor water-works pressure if the nuisance don't go at once.

Water Service.

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Shade Lines on Working Drawings.

Editor American Machinist:

I may be getting myself into trouble again if I venture to say a word or two about shade lines on working drawings; but the relief to my mind will be immediate, while the trouble may be remote.

The universal photographer has made the mechanical draftsman ashamed of his puny attempts at pictorial effects, and now we seldom see the labored shading of curved surfaces and parts in shadow that once were so common, and excusably so. To-day, if we see a drawing elaborately shaded, we know that it is the work of a youth just out of the schools, or of a cheap draftsman without an idea of his own. A designer who wants something made will be content to give outlines and dimensions, and he who is to do the work wants only these particulars. Wasted lines on a drawing are like wasted words in a letter, and they are neither of them "business." It is almost absolutely true that the man of fewest words and the draftsman of fewest lines will each accomplish the most.

Now, I confess to a great weakness for shade lines. They add greatly to the appearance and effect of a drawing. The pages of the "American Machinist" would be less attractive if shade lines were abolished. The contrast of the heavy lines to the light ones is striking and pleasing to every eye. But all this is an argument against shade lines, rather than for them, in any drawing whose sole purpose is to show shapes and dimensions to a workman. To say that shade lines are pretty and pleasing is true enough; but what has that to do with the purpose of a working drawing?

When a drawing gives, say, a plan and two elevations of a piece, we get upon debatable ground at once as to the distribution of the shade lines. With a side elevation and elevations of each end, shade lines upon each end would be impossible, no matter where we assumed the light to come from. If the drawing were of a locomotive, and we stood on the right-hand side of it, with the sun over our left shoulder, then when we got behind the tender the sun would be over our right shoulder and we could make our shade lines to correspond; but when we got around to the front of the locomotive, we would have to bring the sun around with us in order to have any shade lines. Then the question would come up as to where our portable sun would be when we made the plan of the locomotive. But the drawings will be so much prettier with the shade lines that it is highly proper to use them.

The shade lines are of actual use in many places, and in those places and for those uses that is what they are for. They often help to distinguish interior from exterior outlines. They help to individualize the outlines of different pieces, and in assembled machines they serve to show the relations of the parts; but this sometimes leads to embarrassment, as when one piece rests only partly upon another and the heavy shade line cannot properly be continued at the place of contact.

In working drawings of single pieces, all the considerations urging the use of shade lines seem to disappear. Where a line marks a boundary for any dimension, the sharper and thinner and less debatable the line is the better. With a thick shade line I have more than once seen a workman debating as to which side of the line he should measure from. We tell men, of course, they should never measure a drawing at all, but should blindly follow the dimensions that are written in; and yet it is a rule that the scale of the drawing should be distinctly stated upon it. Why give the scale if not for emergent use? I certainly think that many of our working drawings would be better for the workmen, but not so pleasing to look upon, if they were guiltless of shade lines.

Tecumseh Swift.

▲ ▲ ▲

Speed of Milling Cutters and Drills.

Editor American Machinist:

The machinists' tool catalog of J. E. Reinecker contains some rules for the cutting speed and rate of feed of milling cutters, which may interest your readers, as they represent good German practice. I have translated them as follows:

Revolutions per minute for cast steel or cast iron $= C \div$ diameter of the milling cutter in inches.

For cast iron or cast steel, $C =$ about 200.

For wrought iron, $C = 200$ to 240.

For hard brass, $C = 320$ to 340.

The speed is somewhat greater still for soft brass. The feed per minute for cast iron, wrought iron and steel should be from 0.6 to 1.2 inches—the slower feed being used for rough or uneven, and the faster for plane or slightly curved surfaces.

For brass the feed may be increased to 2 inches or more per minute.

Reinecker also gives a table of speeds for twist drills, which he says has been thoroughly tested by practice, in which the revolutions per minute for a drill of given size are more than twice as great as those given in a table compiled by the Cleveland Twist Drill Co. from data furnished them by about five hundred leading American manufacturers. Reinecker says drills are usually run too slow, while the Cleveland Co. recommend that their speeds should not be exceeded. In this matter there seems to be a decided difference of opinion between the best German and the best American practice. Will some of the readers of the "American

Machinist" explain it? Is it due to the difference between German and American metals and drills? As a matter of fact, the temper and quality of each drill and the hardness and properties of the metal being drilled, determine the speed, which ought not to be exceeded; but the only way to find out what that speed is seems to be by breaking the drill.

Since writing the above, I have received the "American Machinist" for May 7th, containing your editorial on the increase of drill speeds. It is of interest to note how closely Brown & Sharpe's speeds correspond with those given in the German table below, which I have converted into English measures for comparison.

Diameter of Drill.	Revs. for Wrought Iron.
⅛	2,300
¼	1,100
⅜	550
½	450
¾	350
1	200
1½	160
1¾	120
2	80.

It seems that our German neighbors are not in advance of us in respect to drill speeds, after all, and the explanation I offered, that the difference in speed might be due to the differences in metals and drills, is unnecessary. SPIRAL.

▲ ▲ ▲

Fastening Piston Rods.

Editor American Machinist:

In the "American Machinist" of May 7th, Mr. F. A. Halsey expresses some very sensible ideas upon fastening piston rods. Personally, I prefer the thread and lock-nut for the crosshead end, and a straight, easy fit in the piston. If the hole in the piston is counterbored, and a steel washer of the diameter of the nut let in for the shoulder of the rod to bear upon, the construction will be both sensible and cheap. I regard a taper fit in such a place as pretty near a relic of barbarism.

Piston rods, as a rule, are made plenty large enough for the reduction necessary for the thread. Many builders even reduce the size of the rod at the end from ¼ to ½ inch before cutting the thread.

I have seen pistons broken in the attempt to force them off the end of a tapered rod. If the fit is not a perfect one, it will not remain tight long. In one case I saw, the rod had driven itself into the crosshead more than a quarter of an inch; and had it not been stopped by the strap on the connecting rod, I suppose it would have kept on until the piston struck the cylinder-head. Of course, this was an exceptional case, but it shows what may happen where a poor fit and a soft casting are combined.

Mr. Elliot objects to the large nut and short wrench for crosshead pins. I have found them "the nicest things in the world," and for rapidity in getting there, and solidity when there, nothing equal to them. F. L. JOHNSON.

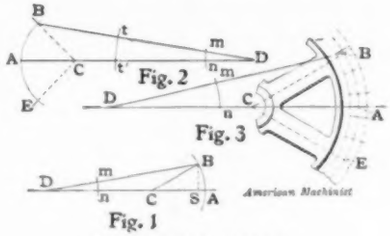

Fig. 1

MEASURING ANGLES.

Measuring Angles Without a Protractor—Spacing Gear Teeth.

Editor American Machinist:

The accompanying figures show a way in which an angle or arc of a circle may be geometrically divided into any small number of parts, whole or fractional—as 3, 4⅓ or 7—without sensible error. The method depends on the fact that the sines of small angles are very nearly equal to the arcs that subtend them, and its application is limited to angles in which this may be assumed to be true. To be perfectly clear: In the angle $B\,C\,S$, Fig. 1, subtended by the arc $A\,B$, the line $B\,S$, perpendicular to $C\,A$, which is the sine of $B\,C\,A$, differs very little from $B\,A$, and the arc and sine may be assumed to be equal for angles up to from 30 to 45 degrees. If it is desired to divide the arc $B\,A$ into a number of parts, say three, then we may prolong the radius $A\,C$ to D, and make $A\,D$ equal to as many times $A\,C$ as the number of parts into which the arc is to be divided; then the angle $B\,D\,A$ is very nearly equal to the required fraction of $B\,C\,A$. For making $D\,m = A\,C$ we have, since $B\,A$ and $m\,n$ are assumed to be equal to their sines, $D\,m : D\,B :: M\,n : B\,A :: 1 : 3$. With the dividers opened to a width $m\,n$, we may divide $B\,A$ into three equal parts. In practice, this method is very simple; for the arc and center being given, it is only necessary to lay off the distance $A\,D$, draw $B\,D$ and take off the required arc $m\,n$ at a radius $= D\,m = A\,C$.

It is just as difficult to divide a small angle into a number of parts with a protractor as a large one; but by this method, angles up to 30 degrees or more can be divided accurately and easily without any guesswork or estimating fractional degrees on the protractor, while angles larger than this may be first bisected and then one-half the arc divided into one-half as many parts by the same method as before. Fig. 2 shows a right angle divided into 4⅓ parts, $A\,D$ being made 4⅓ times $A\,C$. If it is desired to further subdivide the angle, the proper width to set the dividers may readily be found by drawing an arc $t\,t^1$ with a radius equal to such a part of $D\,B$ as the required angle is a part of $A\,C\,B$.

Fig. 3 shows a practical application to spacing the teeth of a spur gear; the number of teeth is 29 and the pitch diameter 4 inches. The angle subtended by the two teeth is 12° 24′. Using a common protractor divided to one-half degrees and reading to 15′, this would be a hard angle to lay off, and anyone who has tried spacing the pitch circle of a gear with the dividers, by trial, will appreciate a better method.

In view of the explanation already given, nothing more need be said than that, with the dividers open to a distance equal to the radius, I first set off the arc $B\,E = 60$ degrees; and then, since there will be $\frac{29}{6} = 4\frac{5}{6}$ teeth in 60 degrees, making $A\,D = 4\frac{5}{6}$ inches and $D\,m$ 2 inches, $m\,n$ is the tooth space on the pitch circle. This also illustrates how an angle equal to any given number of degrees (minutes and seconds, too, for that matter) may be found with accuracy without using a protractor. It is not intended that anyone should get the idea from this that the method given is claimed to be better than using a protractor in all cases. It is merely one of the devices which, like a third triangle, the draftsman can use supplemental to the protractor, to save time.

R. E. HORTON.

[Approximate rules of this kind should be used with a clear idea of their degree of accuracy. Taking the case of an angle of 30 degrees to be divided into thirds, the error may be found as follows: Sine 30° = .5, one-third of which is .16666, which is the sine of 9° 36″, instead of 10°, the true angle. If the circle whose arc is to be divided is of one foot diameter, this error amounts to .0418 inch.—Ed.]

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Power Calculations for a Traveling Crane.

Editor American Machinist:

If it is not asking too much, I would like to fill a little space in the "American Machinist" with an answer to some objections raised by Mr. Chas. L. Griffin.

In the first place, I fully agree with him that the editorial remark was well chosen, and I acknowledge that I did not express myself plainly enough. In the second place, I wish to say that I also agree with what Mr. Griffin says about the insufficiency of a 60 horse-power motor. Mr. Griffin's remarks, though right, are based on a typographical error. I wrote 80 horse-power, not 60.

As to the rest, I get the impression that Mr. Griffin somewhat doubts the truth of my statements of the facts. I was not the designer of this crane, but was called upon to investigate where the trouble might have its origin, when trouble appeared. It was then that I advised to replace the 50 horse-power of motors by one of 90 horse-power. The builders of the crane got all their motors from the Thomson-Houston Co. (now the General Electric Co.), except when other motors were desired by the purchaser of the crane. The 90 horse-power motor was needed immediately, and the Thomson-Houston Co. could not give one of that size, but proposed to send a L. W. P. motor (70 horse-power) wound for 80

horse-power. This proposal was accepted. As the speed of this motor was higher than the speed of the twoW. P. 50 motors which had been in use (25 horse-power each), the gearing had to be changed. Though 80 horse-power was not quite enough, and the motor worked for a short time with an overload, the excellent construction of the motor enabled it to overcome this difficulty.

I would be glad to give the name of the builders of the crane, and also where it was placed. However, when I was in connection with this firm, I was there as draftsman and designer. Since then I have left their employ, and now I do not feel at liberty to talk at their expense—the more so as all the trouble occurred when the crane was not yet delivered.

I do not doubt but Mr. Griffin will be satisfied with this explanation. In case he still fosters any doubts as to the veracity of my statements, I want to say that I have given the details of the case to the editor of this paper. All the points mentioned by Mr. Griffin as swinging load, etc., are easily explained with the knowledge of these details.

A. L. De Leeuw.

[Our correspondent's manuscript for his original article, which is still in our possession, shows that he did say 80, and not 60. The 8 is, however, so made as to be easily mistaken for a 6, and we can hardly blame either compositor or proofreader for the error, especially as their own 6 above the 8 shows them to have been not careless, but uncertain, and to have excusably decided the wrong way.

Mr. De Leeuw's statement to us of the location of the crane fully satisfies us—and, we are sure, would satisfy Mr. Griffin—that the high speed of bridge travel was entirely appropriate to the conditions which had to be met.—Ed.]

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"Paying Wages by Checks."

Editor American Machinist:

Referring to the article in the "American Machinist" of May 14th, "Paying Wages by Checks," I would say that from general observation the system has not shown itself to be a success in most manufacturing establishments where it has been undertaken, and especially so amongst those located in a large city. Workmen seem to think that they work for the money, and not for the things that money will buy; but if paid their wages in checks, the sooner they can convert them into cash the better they seem to like it.

A few years ago I was connected with a foundry concern employing about one hundred men; we adopted the check system of paying off the men, and it worked very well the first two or three months, when gradually the men became dissatisfied, and finally made a general request to have the check system abolished, and to be paid off in currency, which was granted in order to avert a strike. To show how eager men would be to have their checks cashed, I have seen men that would not otherwise patronize saloons, take their checks on pay-day to the nearest saloon to get them cashed. Each man would be expected to "buy something" from the saloon-keeper, who would make it his business to have a supply of currency on hand on pay-days for the purpose of cashing the men's checks.

It would certainly be a grand thing, if it could be done, for the men to deposit their checks, on pay-day, in the bank, and just withdraw whatever was needed from time to time for general expenses, in a way that would show a balance in favor of the depositor. It would have a tendency to make men more saving, and give a great many men a start in life that would never think of a bank account otherwise; but a bank account of this kind is out of the question, as bankers could not be induced to open a check account on such a small scale, and men would soon get tired of making out a check for, say, every 15 or 20 cents' purchase.

If you wish to promote harmony and retain the good-will of your men, pay them off with currency every time.

Chas. A. Fingal.

Chicago.

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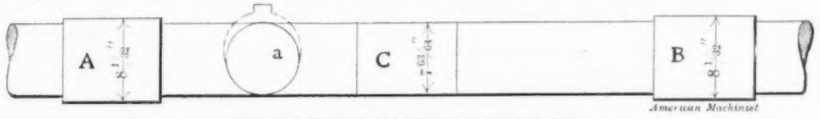
Applications of the "Crescented" Hole.

Editor American Machinist:

I have been interested in your articles on the Keying of Pulleys, in your issue of April 23d. I notice especially Mr. Chas. T. Porter's remarks about boring and keying pulleys on engine shafts. Some years ago, while with the Southwark Foundry Machinery Co., I noticed that Mr. Porter was having the engine pulleys bored out in the manner he describes, and I have always been favorably impressed with the method. Since then I have used successfully the same method for a different purpose.



USE OF THE "CRESCENTED" HOLE.

The sketch herewith shows a horizontal shaft. Originally there was a bevel pinion on this shaft at *A* and at *B*. It was found necessary about four years ago to put in an additional pinion at *C*. To get this pinion to the point *C* it was necessary to have the bore in the third pinion large enough to slip easily over the seats *A* or *B*. I therefore had the third pinion bored out concentric to $7\frac{63}{64}$ inches, which was the diameter of the shaft at *C*. After this was done the pinion was shifted on the boring mill and another cut taken out of one side of the bore, so that the hole was large enough to let the pinion slip easily over seat *B*, which was $8\frac{1}{32}$ inches diameter. The dotted lines at *a* show where last cut was taken out. This pinion runs perfectly true; the key was made a good fit on sides, and the top was a taper of $\frac{1}{8}$ inch to the foot, the key just filling the key-seat on the top and bottom. Since then there has been nothing done to this pinion or key, and they have been running an average of ten hours each working day.

Wm. A. Farnum.

[We have known more than one case of this kind where the hole was bored large enough to slip over the large part and then a thin split sleeve was used, making a much more expensive and a less safe and satisfactory job than that described by our correspondent. Every shopman probably remembers the wheel or pulley that was thrown away because the core was not in the center and the hole would not bore out clean all around, when, except for a little difficulty in boring, it might as well have been used as not, with the key on the slack side. Where the key is used it seems doubtful if more than about one-half of the circle does any of the holding.—Ed.]

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Reversed Momentum—Talc on Tracing Cloth.

Editor American Machinist:

The reason why passengers in English railway trains are shot back upon their seats when the train stops is due to a variety, or a combination, of circumstances; First, an English railway car is lighter than an American car, as a rule, especially with the short cars of surburban traffic. The Westinghouse brake is proportionately very much more powerful in England, because there are more brake cylinders per ton of train, and it is common to see a whole train slide into a station with all its wheels skidded. Passengers are always in a hurry here to alight; half of them doing so before the train stops, and the other half standing up and bracing themselves backward to resist the inertia action; for there is no brake put on the passengers, and they do not tend to stop moving forward so quickly as does the braked train. Owing to the use of long springs, the body of the car, which, of course, drags forward upon the frame, tilts to a small angle, compressing the forward springs and relieving the hinder ones. When the train finally stops, it does so very suddenly, and the springs again resume their normal position, and jerk the carriage body back to an even keel. The jerk of this, coming upon the passengers, who are all pressing backwards in order not to be thrown upon the forward seats, upsets their equilibrium, and very frequently throws them, by reason of

their own exertions, upon the rear seats. The very severe action of the brake, which is tolerated, I suppose, because everyone is in a hurry—which is a statement with which, perhaps, Mr. Carlile will disagree—causes great wear of wheel tires and, no doubt, flat places, and much sparking; but it is indispensable where trains run close up to the platforms under steam, and one often wonders if a train really means to stop. Americans call it the abuse of the brake, but it has got to be done, or we might—"run over the edge," so to speak.

Anent the use of talc on tracing cloth, don't fool around with scraping it for yourself, but buy some from your boot-maker, if you are a man. Ladies use it in new gloves, and it is finely powdered and can be used out of a pepper-box. Its use is not so much to remove gloss as to absorb grease and enable ink to take.

WM. H. BOOTH.

London, Eng.

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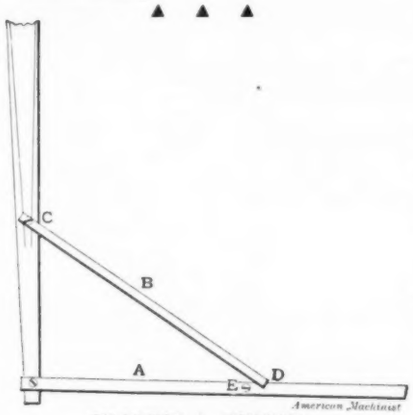

HOLDING A SHIPPER.

Holding a Shipper.

Editor American Machinist:

I wrote you a week or two ago about tool-boards, and I see by the last paper that you were kind enough to print it. That little board by the head-stock was a kind of an idea of my own; so, of course, I thought it was a pretty good thing, and it certainly was quite handy. Talking about that started me thinking about another little thing that I had on that same lathe. This thing might not be of any use to anybody else, but it made running the lathe more comfortable to me. The lathe, when I got on to it, was about two years old, and when it came new the countershaft had two friction clutches on it. They make better friction clutches now than they did when they first came out, and they had been having a circus with those clutches, and finally they had thrown the whole countershaft away and put up another one with square-jawed positive clutches.

This countershaft had not been in use very long when I got on to the lathe, and for a while it seemed to work well enough. The jaws would give an awful knock when the lathe was started, and you could feel the jar in your teeth; but I soon got used to that. After a while the jaws got worn smooth, and then the clutch got a notion of dropping out and letting the lathe stop. Sometimes when it dropped out the pulley would not quite clear, and it would keep on knock, knock, knocking so that you could hear it all over the shop, and the shop was a big one, and then sometimes it would drop off as smooth and quiet as a mud-turtle rolling off the bank; but I got sick of it anyway.

The lathe was a pretty good length, and the shipper was up close to the head-stock. That was all right for chuck work, but it was anything but handy when I had a long piece on the centers and had to cut a thread on the far end of it. I had so much bother with it that finally I got a strip *A* about three-quarters thick and an inch and a half wide, and fastened it to the end of the shipper by a wood screw. The further end of the wooden rod was hung up to the ceiling by a string. This worked all right, and I got so that I never touched the shipper lever at all, but always grabbed hold of this rod wherever I happened to be.

Then came the trouble about the clutch slipping out. The lever pulled backward to throw in the go-ahead driver, and one day it came to me all at once how to hold it. I got the stick *B* and jointed it to the shipper lever by another wood screw at *C*, and then when the clutch was thrown in I found where to cut the notch *D*; and when the end of the stick was dropped into that notch there was no danger of the clutch slipping out. When the stick was not wanted I let it drop on the screw *E*. I used to handle the whole business with one hand, I used it two or three years and I never had any more trouble about the clutch slipping out. I don't know what I would have done if the shipper had worked the reverse way.

MORRIS FULTON.

Philadelphia, Pa.

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Logarithms.

Editor American Machinist:

There are two features in the use of logarithms that Mr. Jackson's articles do not seem to have touched upon—one of these is the avoidance of negative characteristics, and the other is the use of the arithmetical complement of a logarithm. These are both devices that are thoroughly practical, and that I have reason to believe are in constant use by those who make a business of using logarithms; and if Mr. Jackson cared to supplement his articles by an explanation of these two points, I think very likely it would be appreciated by those readers who are just taking up this most useful branch of mathematics.

I wish to raise my voice in favor of five-figure logarithms for ordinary work, as they are so much easier to work with, the interpolations being made mentally, which I do not think could be done with six-figure logarithms, unless the proportional parts table was very elaborate. Five-figure logarithms ought to give four places of natural numbers with accuracy, which I think would cover the majority of cases that the engineer has to deal with. Of course, six and seven-figure logarithms have to be used sometimes; but their use should be restricted to cases involving natural numbers of more than four places.

I show herewith a portion of the table

SECTION OF TABLE OF LOGARITHMS.

N	0	1	2	3	4	5	6	7	8	9
340	53 148	161	173	186	199	212	224	237	250	263
41	275	288	301	314	326	339	352	364	377	390
42	403	415	428	441	453	466	479	491	504	517
43	529	542	555	567	580	593	605	618	631	643
44	656	668	681	694	706	719	732	744	757	769
45	782	794	807	820	832	845	857	870	882	895
46	908	920	933	945	958	970	983	985	*008	*020
47	54 033	045	058	070	083	095	108	120	133	145
48	153	170	183	195	208	220	233	245	258	270
49	283	295	307	320	332	345	357	370	382	394
350	407	419	432	444	456	469	481	494	506	518

as arranged in Newcomb's "Trigonometry and Tables." Each left-hand page begins with an even 100 in the column of natural numbers, as 300, 400, 500, etc.; while each right-hand page begins with the even 50's, 350, 450, 550, etc. Then each even 10 has the logarithms opposite it included between two horizontal rules, as 340, 350, 360, etc.; and there is a little extra space between 343 and 344, and also between 346 and 347. This divides the logarithms up into groups of three throughout the bulk of the table, which makes it much easier to carry the eye along a certain horizontal line of figures, without much risk of selecting the logarithm just above or just below the one desired. As a further aid to using the table, the column rule between the columns headed "4" and "5" is extra heavy, which lessens the chance of error in taking out the fourth figure of natural number. I do not know whether this arrangement is carried out in other tables, but give it here for the benefit of those who know a good thing when they see it.

WALTER GRIBBEN.

[Mr. Jackson's articles on Logarithms,

were not written with a view of exhausting the subject, but to present the essentials in as clear a manner as possible, and at the same time cover all ordinary applications. We can fully indorse Mr. Gribben's opinion of the usefulness of five-figure tables. Mr. Jackson's first article said that "five-figure logarithms are sufficient for the majority of practical calculations."

The section of a table given by Mr. Gribben certainly has some useful points. Another excellent five-figure table may be found in Trautwine's "Pocket Book."—Ed.]

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Tests of Oil.

Editor American Machinist:

In your issue of April 23d you publish an inquiry made by me as to simple methods of testing engine and machine oils. I have carefully studied Mr. W. E. Crane's answer (in same issue) and have experimented in the line indicated by him.

Assuming that one can determine whether or not a given sample is composed of mineral oil alone, or of a compound of mineral with animal or vegetable oil, how is it possible to further determine its value as a lubricant? Have studied several descriptions of oil testing machinery, etc., but would like any information you or your readers can give about quick and simple ways of testing oil which do not involve the use of a chemical or mechanical laboratory.

I have two samples of mineral oil which are quoted at 16 and 45 cents. How can I tell which of the two is better if the labels are changed? We believe that Professor Thurston can do it; but how do your practical readers find out? Have tried looking through it, shaking the bottles and smelling of it; but, not being "Sherlock Holmes," this has not given accurate results.

Please believe that I have no wish to claim too much of your attention, but I do want some information, and believe you or your readers can give it. If they will treat this matter as exhaustively as they do other subjects— "How to Break a Bar of Iron," for instance—it may interest other buyers of oil as well as myself.

EDMUND MORRIS.

▲ ▲ ▲

Foot-Press Girls.

Editor American Machinist:

I would like to say to Mr. F. E. Bright that I have held the watch on a girl for ten minutes while she "nicked" twelve hundred 4-inch dials. I don't know how long she could have kept up that speed, for at the end of that time she had talked me blind (not kicked, as I was above the danger Mr. Herlt slyly hints at) and piled up work till it was in her way. But the fastest work I ever saw was hair-spring wedges by the same girl. I did not time her on that work, but am convinced that she can do 150 per minute for an hour at a stretch. As for her "release," I am sure it can be bought, and if the gentleman will write to me I will send him her address; but I am of the opinion that it would be useless for him to negotiate with her, as he is on the wrong side of the pond. Her parents disapproved of the manner in which the late William Hohenzollern dispensed justice and taxes, and came over before she came to town. But neither they nor she are any better pleased with the way young Billy H. is cutting his jib.

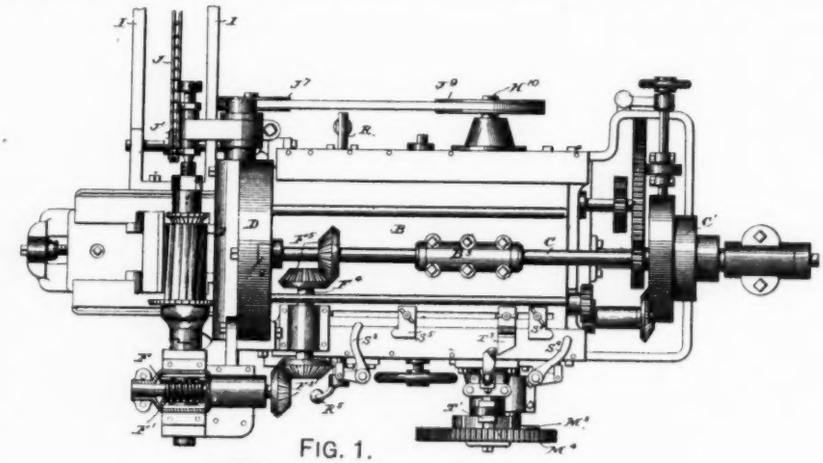

FIG. 1.

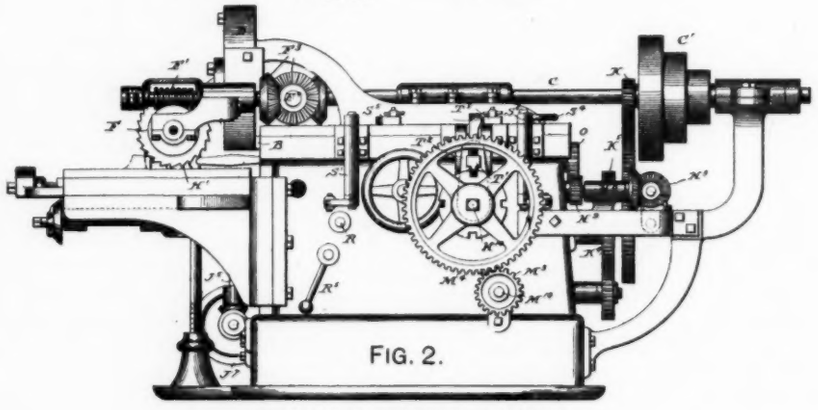

FIG. 2.

AUTOMATIC MILLING MACHINE.

What is Mr. Bright doing over there in the land of the pretzel, anyhow? Why don't he come home if he wants to keep up with the procession? Come to a good town; come to Peoria, and I will hustle around and find you something to do.

Peoria, Ill. D. M. HUMISTON.

▲ ▲ ▲

Strength of Engine Shafts.

Editor American Machinist:

It appears to me as if a mistake has been made in giving the answer to Question No. 101 in the current issue, for I think that the formula that you give was taken from some architect's book, given for the purpose of determining the deflection of a cast-iron beam used in the construction of a building. Is anyone building engines with cast-iron shafts, and putting a load of 100,000 pounds on the middle of them, when the diameter is only 16 inches and the distance between bearings 14 feet? It appears as if the answer should have been given for a wrought-iron shaft, in which case the modulus of elasticity would be 26,000,000 pounds, as given by some authorities. I may be wrong in my assumption, but give my ideas for what they are worth.

W. H. WAKEMAN.

[We sincerely hope and trust that no one is building an engine with such a shaft with such a weight upon it. It is very clear that the deflection as we computed it, applied alternately at any opposite points for each revolution, would very soon break it; but our opinion was not asked for upon that point.—Ed.]

▲ ▲ ▲

Threading Dies—Soap Suds or Lard Oil?

Editor American Machinist:

I wish to thank "Treb" for his kind information in regard to threading dies. I have no doubt but that a die made the way he describes in your number of May 14th would give good results. The teeth seem to be good and strong, and the holes are of such a size as to afford plenty of room to chips. I have suggested this style to the boss, but he does not seem to favor it, and I am sorry not to have an opportunity to give it a trial. In the meantime we are keeping right on increasing our scrap heap.

It would also be interesting to know if there is any saving in using soap water in-

stead of lard oil. It seems to me, taking into consideration that speed and feed must be slower in using soap water, and tools wear out much quicker, that there is no saving at all and lard oil would be the cheapest after all. MONITOR.

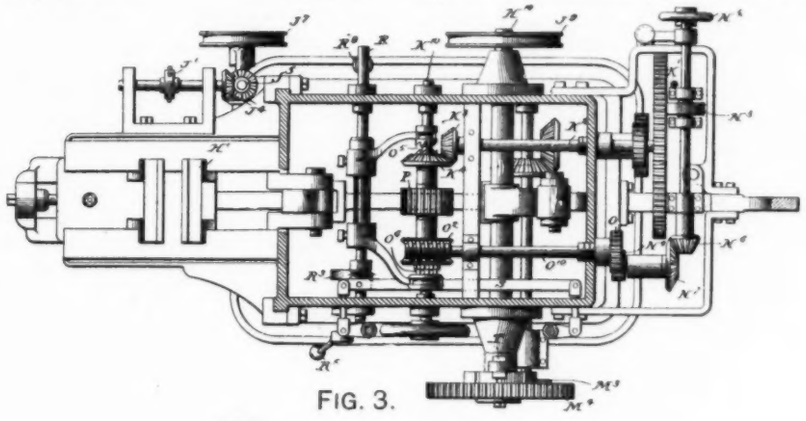

FIG. 3.

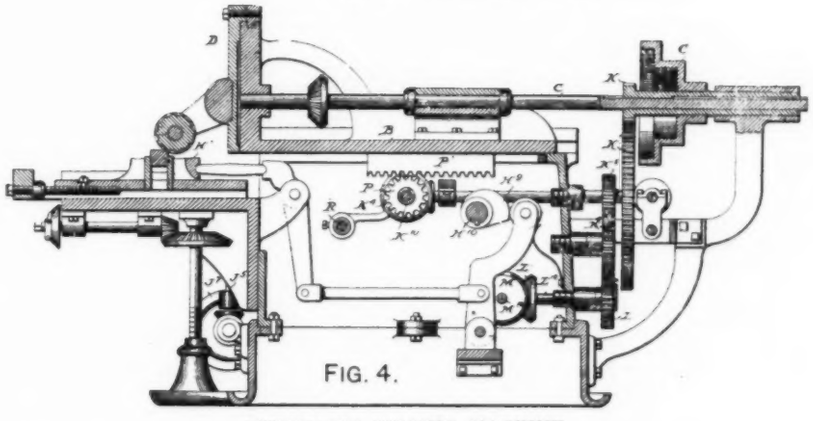

FIG. 4.

AUTOMATIC MILLING MACHINE.

Recent Inventions in Metal-Working Machines.

Figs. 1, 2, 3 and 4 show in plan, side elevation, sectional plan and vertical, longitudinal section, an automatic milling machine, the invention of Messrs. W. & S. Moltrup, of Beaver Falls, Pa.

The machine is designed to automatically feed from a bar of stock, clamp, shape, cut off and discharge formed pieces, and is especially adapted to finish standard taper keys.

C^1 is the main driving cone and the cutter—which comprises formed mills and a cut-off saw—is mounted on the reciprocating ram B, with a swivel head D, and is driven through the train $C\ F^5\ F^4\ F^3\ F^1\ F$.

The knee is provided with the usual vertical and horizontal adjustments, best shown in Fig. 4, which figure also shows the automatic work clamp H^1, driven, as will be readily understood, from cam H^9 on the intermittently revolving shaft H^{10}.

Through train $K\ K^1\ K^2\ K^3\ K^4\ P\ P^1$ the ram is given its quick return, the forward feed being accomplished (see Fig. 3) through $K^1\ N^3\ N^6\ N^7\ N^9\ O\ O^{10}\ O^2$, and this rate of feed is varied by moving friction wheel N^3 across the face of K^1.

Both K^4 and O^2 run loosely on shaft K^{10}, to which P is keyed, and either bevel or worm may be connected thereto by the clutches $O^4\ O^5$, which are controlled by shaft R. This shaft is, in turn, shifted longitudinally from link S, which receives its motion from levers $S^3\ S^4$, driven by adjustable trips $S^5\ S^6$ on the ram (Fig. 1). Shaft R has also a triangular toe-piece which rides over a capped spring R^8, giving to the clutches a rapid, positive throw; while both clutches may be locked open by wedge R^3 and hand lever R^5.

It is, of course, necessary to unlock the vise and feed the stock only at the end of the cut and while ram B is retracted, and these operations are accomplished as follows: Through train $K^5\ K^6\ L\ L^1\ L^{10}\ M\ M^{10}\ M^3$ (Figs. 2 and 4) is driven gear M^4, which is clutched to shaft H^{10} by the action of dog T^1 and hinged trip T^5 (Fig. 1), the latter adjustable on the ram.

A single revolution of H^{10} serves to unlock and relock the vise and, while it is unlocked, feed forward the stock, by means of the train $J^9\ J^7\ J^5\ J^4\ J^1$; this last carrying a chain J attached to a carriage on ways $I\ I$, in which carriage the outer end of bar of stock is clamped.

It will be seen that the machine is entirely automatic, combines features of both shaper and milling machine, and can be adapted to a wide range of plain milling on small duplicate parts.

Fig. 5 shows in side elevation a pulley-crowning machine, the invention of Mr. S. H. St. John, of Canyon, Colo. The machine is easily adapted for crowning either wood or iron pulleys.

The cutters d are adjustable in radial slots of the head D, and the work X is adjusted, by the parallel chain-connected screws M, to such height that the cutters strike it at, or but slightly above, the center. As the pulley is set with the center of its face coincident with the axis of C, and as the cutters travel in a circle whose radius may be varied to vary the amount of crowning, it will be seen that any point in the center of the pulley face, when shaped by the cutters, must be farther from its axis than corresponding points on the edges.

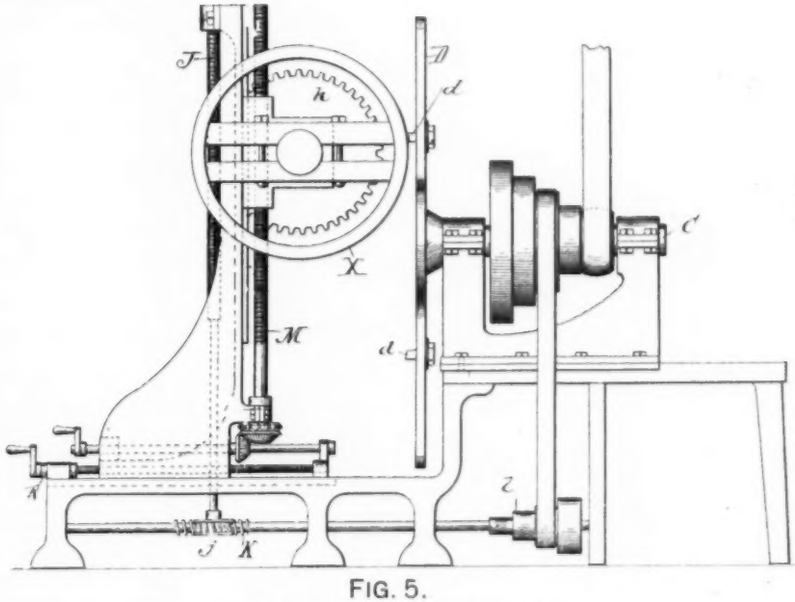

FIG. 5.

PULLEY-CROWNING MACHINE.

The pulley is revolved by the train $l\ K\ j\ J$; the last a worm meshing with worm wheel h on the pulley-carrying shaft. Screw R adjusts the frame laterally for different-sized pulleys.

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Copying Machine Designs.

Besides the many good things in machine construction for which Cincinnati and vicinity are to be credited, it is not to be denied that there is and for years has been from that quarter, more complaints of copying and stealing designs than from any other locality in the country. Just now discussion of this phase of the business is particularly lively; and if the ethics of the question may be decided from the general consensus of opinion, it seems likely that the city named may do very much towards the establishment of a code of ethics which shall apply to such work and in time be universally recognized—at least, if free expression of opinion will bring this about, much will be done in that direction.

Years ago, John Steptoe, of blessed memory, seems to have established in Cincinnati the practice of making absolute copies of other machinery builders' designs. It was his custom to purchase a machine, take it to pieces and give the parts to his workmen in lieu of drawings. Having little or no conception of what good work meant, he succeeded in imitating proportions and appearances only, his deficient fittings and workmanship rendering his copies little better than caricatures of their originals. The spirit of the practice thus started years ago seems still to prevail in the vicinity in which he lived, though, of course, there are shops there that are entirely free from it, and, in fact, are the greatest sufferers and complain most bitterly of it.

We find that those builders who either are themselves machine designers or employ such men, are disposed to put a rather liberal construction on the term "copying," and that a good deal of what is really copying can be done without provoking much severe censure, so long as there is sufficient variation from the original design to enable one to readily distinguish between the original and the copy without looking at the name-plates; but when parts of the original machine are used as patterns in the foundry, and in place of drawings in the machine shop, or where a cheap draftsman actually measures every part of a machine and duplicates it as exactly as possible, this is usually denominated as no better than other kinds of stealing; and when a concern appropriates the engravings in another's catalog and duplicates them exactly, showing every wrench, gear wheel and pulley arm in exactly the same position, more severe terms are usually employed in characterizing such practices.

A Cincinnati wood-engraver, seeking work in Hamilton, innocently showed, as a sample of his work, proofs of engravings which were duplicates in every particular of engravings in the catalog of the establishment in which he was seeking work. Upon being questioned, he said his copies were given to him in the form of prints from wood-engravings which had been cut out and pasted on sheets of paper. He photographed these upon his blocks, and, of course, duplicated the engravings.

One of the engravings so made had been previously sent to this office, with a request to use it in an illustrated descriptive article. It was declined on the ground that we are now using only our own engravings, and are illustrating only those machines which we consider have at least some new features or points of technical interest.

Inquiry develops the fact that, where the original builders are using solid forged steel crank shafts for their machines, the copyists are using a plain round bar with a cast sleeve shrunk on for the crank. This is probably fairly illustrative of the difference between original machines and copies of them. Yet it is not unlikely that this firm would tell a prospective customer that their machine was in every respect an exact duplicate of the Hamilton machine—for less money. A man who was in the market for a planer some time ago, and who proposed to buy a well and favorably known Cincinnati machine, actually bought one in another shop at a lower price upon the basis of a statement that the machine was the exact duplicate of the other in every respect—as exact a copy as close calipering and measuring of an original could produce—for less money.

There is no moral defense for such a practice. Someone must pay for machine designs and for draftsmen's labor. It is certainly the same in principle as any other kind of stealing when this labor is appropriated in such a manner, and it is our belief that the courts ought to and possibly would afford relief in such cases, independently of the question of patents.

It is also our belief that when a man sells a machine to another, he sells only that particular machine, and not the design of it, nor the skilled labor which determined by computation or by careful experiment the proportions of it; and if there is in the common law no principle that will give the original builder any protection from such copying as we have described, then there certainly ought to be, though, of course, we admit that the location of the line between legitimate following of good established practice and illegitimate and dishonest copying might in some cases be difficult. But there ought to be no doubt whatever as to the character of the practice of measuring and closely following every size and every detail of another's design, and the originator of a machine so copied ought to be able to secure an injunction and to recover damages. If he cannot do so, then the law fails to protect him in his plain rights.

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Admission Requirements to Engineering Schools.

In our last issue we published another communication on the above-named subject.

That portion of our correspondent's letter which touches upon admission requirements, adopts the conventional idea that high scholastic requirements insure the selection of the best men. This we deny. As we have said before, the effect of such a system is not to select those of the greatest ability, but those who have enjoyed the best opportunities in a particular line.

We, no more than our correspondent, would favor low admission requirements in a broad sense of that term. We would only admit those who by their industry and application have made the best use of their time. We consider, however, that a portion of the applicant's time may have been just as profitably spent in going through an apprenticeship as in attending preparatory schools. The acquirements obtained by some in the shop should be recognized as of equal value with those obtained by others at school, and the possession of either to a sufficient degree should qualify for admission. As long as the schools maintain shops, they admit the value of shop training, and we are unable to see even the foundation of an argument against the ranking of shop experience as an alternative admission requirement—shop experience being ac-

cepted from those who have it; and mathematics, languages and the rest from those who have them. Of far greater importance than acquirements of any kind is fitness and taste for the work, and we know no better test for a boy's fitness or love for the pursuit of mechanical engineering than his having deliberately served an apprenticeship. Compared with the mere capacity to learn lessons in remotely related subjects, its superiority is a thousandfold. While, therefore, the conventional requirements test the applicant's opportunities and the use he has made of them, the apprenticeship test would to a large degree determine what the school test cannot—the applicant's fitness for his work.

The correspondence which we have published on this subject shows that these facts are already recognized by educators to a gratifying degree, and we believe the time will come when they will be universally acknowledged as truisms.

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An Old and Honored Blacksmith Dead.

John Reid, for many years a practical blacksmith and horse-shoer in this city, died on June 2d. He was born in Ireland eighty-three years ago. He enlisted in the Ninth Royal Lancers and served in India. He came to New York in 1855 and started a blacksmith shop. He was located at Broadway and Forty-fourth street, and was considered such a master of his trade that the best trotting horses of the country were sent long distances to his shop to be shod. J.I.C., Goldsmith Maid, General Butler and others were regularly sent to him.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(113) F. M. K., Warren, Pa., writes: Suppose we take a pulley of any diameter and, say, 3-inch bore, and balance it upon a 1½-inch shaft; will that pulley be balanced as accurately as if it was balanced on a 3-inch shaft? A.—A pulley cannot be balanced as accurately upon a shaft that is smaller than the hole. See our issue of August 22, 1895, page 671, where this is explained.

(114) J. H. L., Texarkana, Tex., writes: I have to determine which way to convey power in a certain case, and I do not know which is best. It can be done by sprockets and chain, or by bevel gears. Which will be the most enconomical in power consumed and the most durable? Ball bearings are to be used, and perfect rigidity and perfection of workmanship are assumed. A.—So little data is given us in this case, especially as to speed and power and the relative location of the shafts, that it would be unwise to hazard an opinion. Chains and sprocket wheels usually run in situations adapted to spur gears rather than bevel gears. We can say in general that the chances are decidedly in favor of the bevel gears, especially as to durability.

(115) D. C. S., Connellsville, Pa., writes: I have charge of an ice plant and am bothered by the steam condenser scaling—a Frick submerged condenser. We have artesian wells, and the water from them causes a sandy scale to come upon all steam pipes that are in contact with the water. Some people say that it is white sulphur in the water. The substance that comes out at the steam joints tastes like lye. Please tell me what will remove the scale by putting it in the condenser and boiling it—something that will not injure the boiler, as we feed from the overflow of the condenser. The boiler does not scale, but a white substance like lime forms in it, which does not cake. A.—We are unable to advise from the above statement of the case. The water and the deposits spoken of should be analyzed by a competent chemist. It seems evident that the water is very bad for both the condenser and the boiler, so that here would be a very proper place to use a device for cooling the water from the condenser and using it over again. Several of these devices have been described or mentioned in our columns lately, and they are coming into general use.

(116) Subscriber, Bennington, O., asks for instructions for setting the valve of a Garr-Scott traction engine, which is fitted with a link motion. A.—We are not acquainted with this engine, or the peculiarities of its valve gear. If the engine is always worked in the full gear, it is only necessary to set the valve for equal lead at the two ends of the cylinder, as would be done with a plain slide valve—going through the operation for both forward and backward gears. After the valve is set for one gear, any change to equalize the lead for the other gear should only be made by changing the length of the eccentric rod for the second gear, as any change in the valve rod would disturb the adjustment already made for the first gear. After setting for the second gear, the valve should be examined for the first gear, as the second setting is liable to disturb the first. If the link is to be used in notched-up positions, it will be necessary to examine the valve for these positions, as the lead is less when notched up than in full gear, and if too little lead is given to the full gear there may be none or less than none when notched up. Should this prove to be the case, the lead for the full gear should be increased and the operation be gone over again.

(117) A. A., Beloit, Wis., sends us a sketch comprising a vertical water-wheel shaft, 65 revolutions per minute, with a bevel gear of 76 teeth driving a bevel pinion of 26 teeth upon a horizontal shaft; a pulley on this shaft drives a 30-inch pulley on a second shaft, and a 76-inch pulley on this second shaft drives to a 24-inch pulley upon a dynamo, the speed of the latter being about 800 revolutions per minute, and about 50 horse-power being transmitted. Then a second sketch is given, showing, instead of the first gear, a pulley 9 feet 8 inches diameter on the vertical water-wheel shaft, and an 18-inch quarter twist belt driving to the 30-inch pulley on the second shaft, and the 76-inch pulley driving to the 24-inch pulley on the dynamo as before; and the question is asked how much power would be gained by the latter arrangement, or by an equivalent rope drive. A.—We do not think that there would be any appreciable gain of power by either of the proposed changes, and cannot consider either of them as good as the gears. We have never known a quarter twist belt as wide as 18 inches to run satisfactorily, either with or without an idler or carrier pulley. The rope drive would be more expensive, but could be arranged to run all right; yet even then we cannot see any advantage over the gears. The gears may be in bad condition; but if they are all right, or can be put right, we would not change them.

(118) H. H., Madison, Wis., asks for a method of calculating the pitch diameter of a bicycle sprocket wheel, the diametral pitch and the depth of the tooth; he also asks whether there is any difference between the meaning of the pitch of a gear and the pitch of a sprocket wheel, and, if so, what is the difference; also what pitch is most used on bicycles. A.—We may well ask what our correspondent expects to do with these particulars if he gets them, which he is not likely to. The shapes of gear teeth are fixed, while those of bicycle sprocket wheels are not. There are so many different styles of chains in use, each calling for a different shape of sprocket, and they take hold of the chain in so many different ways, that any definitions which we might invent for the sprocket wheel, to correspond with the pitch dimensions of a spur gear, would be found in many cases not to fit. The chain and the sprocket wheel may be regarded as a rack and pinion, and then the pitch would be the distance from one point in the chain, when straight, to the next similar point, and when the chain was lapped around the wheel it might be considered as forming a regular polygon, the pitch diameter of which would be the diameter of a circumscribing circle. Thus, if the pitch of the chain was 1¼ inches, and the wheel had 12 sprockets, 1¼ inches would be the side of the polygon, and, as the diameter of the circumscribed circle is to the side of a duodecagon as 1 : 3.8638, the pitch diameter would be $3.8638 \times 1.25 = 4.83$ inches. The diametral pitch, then, would be $12 \div 4.83 = 2.48$. It is to be understood, however, that the computations regarding the pitch of spur gears are not properly applicable to bicycle sprocket wheels.

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Business Specials.

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The Use of the Slide Rule.

BY F. A. HALSEY.

Part II.—Multiplication.

In the days of the English slide rule, the upper scale of the body was designated and stamped as the "A" scale, the upper one of the slide the "B," the lower one of the slide the "C," and the lower one of the body the "D" scale. The present arrangement of the French rules is undoubtedly better than the old English arrangement, but the omission of these designating letters is to be regretted, as they formed a most convenient method of naming the different scales. In what follows, the above letters will be used to indicate the different scales, and will be found on the engravings.

The engravings which follow have been made directly from a slide rule, and give the sub-divisions as found on the rule. As, however, in the use of the upper scales, but a portion of the length of the rule is ever used in any one problem, only that portion of the rule actually used is shown, thereby increasing the openness of the divisions with a given size of engraving. It is believed that this method of showing the instrument on paper will enable the reader to grasp the operations more readily than the usual assortment of diagrams, which bear no resemblance to the actual rule. In carrying out this idea, however, it is necessary to show both upper and lower scales; but it is to be understood that in the problems which follow, up to those which take up the subject of square roots and areas of circles, the upper scales only are used.

As a first problem, multiply 2 by 3. The procedure is shown in Fig. 2. Set 1 of B below 2 of A. Above 3 of B will be found 6 on A, which is obviously correct. The explanation should be obvious from what has preceded. The distance from 1 to 2 on A is really the logarithm of 2, and the distance from 1 to 3 on B is the logarithm of 3. These logarithms the rule has added together. The logarithm of 2 plus the logarithm of 3 is the logarithm of 6, which is read from scale A.

In the same way, multiply 3 by 4, as in Fig. 3. Set 1 of B below 3 of A. Above 4 of B will be found 12 on A. The reading 12 will be plain if we remember that the middle mark of A is 10, and the 2 to the right is now 20. The space between 10 and 20 is divided into 10 main sub-divisions, of which the first is 11, and the second, with which we are now concerned, 12. The next, which we do not now want, is 13; the next 14, and so on. The same result could obviously be obtained by setting 1 of B below 4 of A, when above 3 of B would be found 12 on A, as before. This the reader should do, with an actual rule.

Had our problem been to multiply 30 by 4, the setting of the rule would have been as before, the 3 of A being now read as 30. The middle mark (as will be seen by running up the scale) would now be 100; and the 2 to the right, 200. The first main sub-division to the right of 100 would be 110, and the next 120, which is the product of 30 by 4. This illustration is not given to show the method of finding the true value of the product when multiplying large numbers, which is better done otherwise, but to show the manner in which the numbers of the rule lose their absolute values in the mind, and really represent figures only. In the same way, multiplying 300 by 4 would have given 1,200, since, if the first 3 of A represents 300, the middle mark will represent 1,000; the next main sub-division, 1,100; and the next, 1,200. It should be noted here that, having set the rule to multiply by 3, we can multiply any number by 3. Thus, opposite 5 of B we find 15 on A; opposite 6 of B we find 18 on A; opposite 7 of B, 21 on A, and so on. This feature is characteristic of all slide-rule work, and is often of great convenience.

At this point the reader is in a position to begin the education of his eye. Let him go through the entire multiplication table with the rule. First set to multiply by 2, and go through the 2's; then set to multiply by 3, and go through the 3's, and so on for the entire table. Going through problems of which the results are known will enable the readings to be checked at once, and the education of the eye will be rapid.

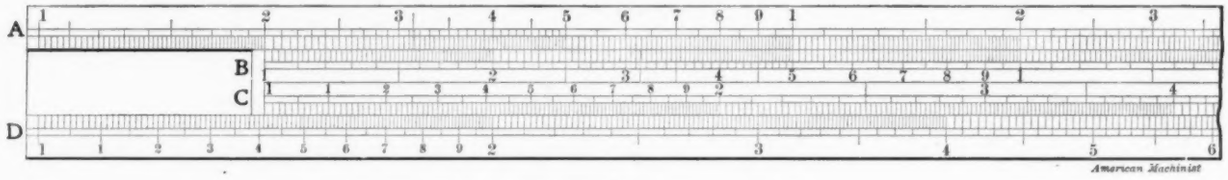

Fig. 2.

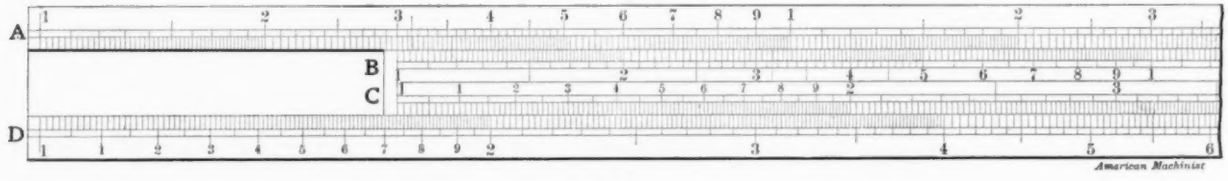

Fig. 3.

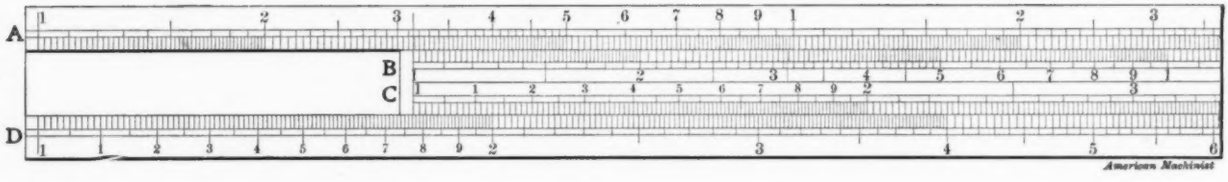

Fig. 4.

The next step is the multiplication of fractional numbers. When using the slide rule, all fractions must be in decimals. The rule will change vulgar to decimal fractions, or vice versa, in a twinkling, as will be shown later; but decimal fractions only will be considered here. Multiply 3 by 2.5, for which the rule is already set in Fig. 3, 1 of B being below 3 of A, and above 2.5 of B will be found 7.5 on A. If we wish to multiply 3 by 2.75, the same setting will give it, as above 2.75 of B will be found 8.25 on A. In this case the last figure must be estimated, as the divisions are not fine enough to give it. It is in thus estimating the last figure (which must often be done) that the small error to which the slide rule is subject comes in. The first factor of our multiplication, or indeed both factors, may be fractional. The circumference of a circle is found by multiplying the diameter by 3.14, and is a

case of fractional multiplication. Place 1 of B below 3.14 of A, as in Fig 4. (Most rules have a special mark on A for 3.14, as in the present case.) Now, above 2 of B we find 6.28 on A, which is the circumference of a 2-inch circle. In the same way, above 3 we find 9.42, and above 4 we find 12.6. In the same way, we may read off the circumference of a 2.3, 6.7 or 8.15-inch circle. In other words, the rule as now set is a complete table of circumferences. This offers another admirable means of educating the eye. Let the reader turn to a table of circumferences, and by it check off his determinations of a large number of circles by the rule. This should be done before going further. This education of the eye must be accomplished. There is no better way of doing it than this, and now is the proper time to do it.

(To be Continued.)

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Fatal Success of an Aged Inventor.

Mr. H. S. Roper died suddenly at Cambridge, Mass., on June 1st, while exhibiting a steam bicycle of his invention. Mr. Roper was seventy-three years old. He had a race upon the track with Tom Butler, a very fast wheelman. He defeated Butler, and, much elated, started on a record-making run. Several spectators cheered him as he flew past the grand stand. On the seventh round it was noticed that the wheel was going very unsteadily and on nearing the stand Mr. Roper fell off, and the wheel fell upon him. When picked up he was found to be dead, and an autopsy showed that the death was due to heart disease.

Mr. Roper, as a machinist and inventor, had been associated with Elias Howe, Alvin Clark and Spencer in the manufacture of their specialties. He had been interested in steam propulsion more than forty years. He applied steam to an old velocipede in 1869. The perfected machine by which the inventor died, was a safety with the engine between the wheels. Its weight, complete, was 150 pounds. It had made 40 miles an hour on the road.

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Electrical Theory and Practice—"Let Us All Claim Everything."

"Obedient to the advice of the 'Electrical Journal,' given in this column some time since, the bulwark of conservatism heretofore surrounding the doings of electrical scientists has been irrevocably broken down, and now it seems that all hands and the cook are storming the citadel of popular approval. To date we are able to report that Mr. Edison seems to be in the lead, with Mr. Tesla a close second, and the rest nowhere. There is apparently a common fear that some other fellow will do something creditable. It has therefore become necessary for us to 'claim everything.' In this way we will be on hand if anything good results. It is true that we lose a good deal of time running the publicity and promotion shop of our factory, but it is a safe plan and worthy of emulation and critical attention."—"Electrical Journal."

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For Better Patent Solicitors.

The following from the annual report of the Commissioner of Patents is commended to the attention of those who have to do with the Patent Office:

In a former report I had the honor to recommend that authority be given to the Commissioner to frame rules, subject to the approval of the Secretary of the Interior, for the admission of practitioners before the office to an organization to be designated the patent bar. Further reflection has led me to attach increasing importance to this measure, and has induced a belief that a noticeable evil from which inventors and the public suffer would be mitigated, if not almost removed.

It would be a manifest injustice to establish a patent bar to be composed exclusively of lawyers. Some of the most capable and honorable solicitors practicing before the office have chosen other professions than the law, and it not infrequently happens that the mechanical expert is as well qualified to conduct the work of a solicitor before the office, as those who conduct at the same time a patent-law practice before the courts. No suggestions now made or that have been heretofore made, had any thought of excluding men of this class from any of the privileges of the proposed patent bar.

It not infrequently happens that a practitioner, perhaps under the stimulus of a contingent fee, has so presented a meritorious invention that no adequate claims are found to be allowed. It is obvious, on careful inspection, that claims might be drawn which would cover the invention and thus secure to the inventor that which was his own, and which would be allowed in a later action on the case; but instead of bestowing the requisite attention and labor upon the case, the unfaithful solicitor promptly directs the cancellation of all claims objected to, and thus puts the application into condition for allowance with an inadequate claim. Again, the unscrupulous solicitor takes an appeal, or a series of appeals, upon a case that is squarely and indubitably met by the references, for no assignable reason other than to secure from some unlettered client the appeal fee; for in such cases, though the appeal be regularly taken, no appearance is made before the appellate tribunal, no brief is filed, and the inventor is left in no better state but somewhat the worse for this petty system of plundering. Another class is not infrequently seen about the elevator in the Patent Office, lying in wait for those who have traveled hither for the purpose of presenting their inventions in person. They are without a known place of business other than the attorney's room in the Patent Office; and against all these the establishment of a patent bar would provide a barrier, and it would, to some extent, insure to inventors a guarantee that those who have a right to practice here are men of recognized integrity and of ascertained fitness and capacity.

As matters now stand, any one who has not been proved before the Patent Office to have retained the money of his client or to have been guilty of other gross misconduct, and so refused recognition under section 487 of the revised statutes, is permitted to practice before the office, whatever his attainments may be, whatever his character or capacity.

It is thought that a conservative regulation upon the subject of admission to practice before the office is necessary for the protection of inventors against the greed of some who, as patent agents, solicit their business, and against the incompetence of others.

I therefore respectfully recommend that authority be given by legislation for the enactment of rules and regulations concerning the admission to a solicitor's bar of those entitled to practice before the Patent Office.

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Commercial Review.

NEW YORK, SATURDAY EVENING, JUNE 6TH.

Engines, Boilers, Pumps, Etc.

It is fortunate if we can bear in mind the role that politics and the season are playing upon the stage of trade, for in view of this fact, it is possible to consider, without utter despair, the present state of the market. Were we to say that, according to the appearances in this quarter, steam engines are in a worse situation to-day, commercially speaking, than they ever before have been since their invention, we should come about as near the truth as the average trade report. The New York agent of one of the old and well-known companies remarked yesterday: "This is the dullest time we ever experienced; nobody expects to make any money." It seems to be the case with some, that if they can clear the cost of their engines they are doing pretty well, nor are all fortunate enough to do even this. But this is presenting the situation from its dark side only, and perhaps there have been periods since 1892 when business was even more at a standstill than it is at present.

According to most reports, boilers, like engines, are very dull, notwithstanding at least two well-known concerns could be mentioned which find trade active.

A fairly bright spot on a gloomy background is the city office building demand for steam plants, which has loomed into view. Announcements have just been made of the contract given out for the sky-scraping St. Paul building, of this city, now partially erected. Eddy dynamos have been chosen to furnish light, Straight-Line engines to run them, and the Babcock & Wilcox Company is to supply boilers. The same company equip Have-

meyer's new building, Prince street and Broadway, with 500 horse-power of boilers, the Manhattan Hotel with 600, and are erecting 1,000 horse-power for Altman's store, on Sixth avenue.

But we do not mean to imply that the building trade this year is at all unusual. A leading valve company, of whose business it is said to be an important factor, is having an exceedingly unsatisfactory time.

The market for steam pumps is acknowledged, by those concerns with whom we have been able to communicate, to be dull, flat, and generally uninteresting. Not a great deal of water-works construction is said to have been done this year.

We learn that the Roberts Boiler Co., manufacturers of marine boilers, have been able, during the past few years, to pay 10 per cent. dividends, although, owing to the stringency of the times, the surpluses have not been as great as formerly, and they consider that this year has been about as good as last.

A steam pump manufacturing company write us from the West: "Business in the month of May compares very favorably with last year, and is about the same as in April. In some lines of our work business is fairly brisk. Business generally is quiet."

The Kensington Engine Works, of Philadelphia, which manufacture steam goods, report of their business: "While the present business situation is one that is far from satisfactory, yet we have received such an amount of orders that we do not see that we have any right to complain. We have had our share, and rather more. We have done more business in volume, but the profits have shrunk to such an extent that there has been no pleasure in doing it. This is the situation as we find it, namely, that we are simply selling goods without a profit. That is, our men are getting the benefit, and we are going without any profit. This condition must change, or we will overcome it by making no attempt to take orders, without we can be sure of a profit; meanwhile, we will amuse ourselves as best we can, and wait until times improve, use what little money we have left, and go fishing, and let some other fellow take the work."

A feed water heater company in one of the Eastern States report: "The demand for feed water heaters for the last month was better than we anticipated. There has been a material decrease in the number of steam plants that have been erected for the last few months, but our May trade held up very well."

In steam specialties the state of trade is apparently better than in the larger lines of steam machinery, although the prices still are low. These goods are more or less of a necessity, for which there must always be some demand while engines are kept running. A leading house, selling steam gages and similar specialties, has found the first half of this year better than last and the month of May fairly good, on the average, although trade fell off after the first fortnight. Another concern has had 30 or 40 per cent. more business in the year preceding May, 1896, than in that preceding May, 1895, and they think trade is now better than it was a year ago. Other houses substantiate this latter statement, although the factory represented by one is stated to be only one half supplied with work.

Iron and Other Metals.

Still the intense dullness which has dominated the market is reigning. In this quarter no improvement is manifest. Reports have come from Pittsburg and Philadelphia which take rather a more hopeful view of the situation than some of those in the past, but nothing to lay very much stress upon, especially since they do not agree with all authorities. Furnaces are going out of blast, and, to add to the difficulties, labor troubles are feared.

There is somewhat less activity in copper in this market than a short time since, but still a fair volume of business has been transacted. Advices from London have been bullish. A number of the Lake Superior mining companies are reported to have placed the asking price of their copper at 12c. for deliveries during the next six months.

The tin market has been fairly steady, but no great amount of business has been transacted. The total official visible supply of the metal, not including stock held by speculators in the Straits settlements, is 30,843 tons, which, compared with the visible supply on June 1st, 1895, exhibits nearly 20 per cent. increase. Including that stock, the increase is estimated at 40 per cent.

The lead market has been flat and uninteresting this week, thus following the precedent set by many past weeks.

Spelter is in much the same condition as lead. Some grades of spelter may be obtained at prices lower than those quoted for good brands.

Quotations.

NEW YORK, Monday, June 8th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 50 @ $13 25
No. 2 foundry, Northern	12 00 @ 12 50
No. 2 plain, Northern	11 00 @ 11 50
Gray Forge	11 00 @ 11 75
No. 1 foundry, Southern	11 50 @ 12 00
No. 2 foundry, Southern	11 00 @ 11 50
No. 3 foundry, Southern	10 75 @ 11 00
No. 1 soft, Southern	11 25 @ 11 50
No. 2 soft, Southern	11 00 @ 11 25
Foundry forge, Southern	10 25 @ 10 50

Bar Iron—Base, in Carloads—Mill price, on dock: common, 1.10 @ 1.20c.; refined, 1.20 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.70c

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, about 1.75. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 11½ @ 11⅝c.; electrolytic, 11⅛ @ 11¼c.; casting copper, 10¾ @ 10⅞c.

Pig Tin—For 5 and 10-ton lots, about 13.50c. f. o. b.

Pig Lead—In carloads, 3.00 @ 3.02½c., f. o. b.

Spelter—In carload lots, New York delivery, 4.10 @ 4.12½c. asked for good brands.

Antimony—Cookson's, 7¼ @ 7¾c.; Hallett's, 6½ @ 6¾c.; Japanese, 6½ @ 6⅝c.

Lard Oil—Prime city, present make, 43 @ 45c., according to quantity.

Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Practical mechanic, theoretic education, desires to change. Address Mechanic, care AM. MACHINIST.

Comp. draftsman wants pos., exp. desigr., eng., water tube boilers, gen. mach. BOX 143, AM. MACH.

Planer hand wants position; accustomed to large or small wk.; rapid, accurate. BOX 145, AM MACH.

Wanted—A position by a foundry foreman, 10 yrs' experience on machinery and general jobbing. Good reference. BOX 153, AMERICAN MACHINIST.

Young mechanical draftsman, shop and drawing room experience, desires to change; has knowledge of photography. BOX 162, AMERICAN MACHINIST.

Mechanical draftsman and successful designer, 10 years' experience automatic and general machy., wants permanent position. BOX 160, AMER. MACH.

Wanted—3 or 4 first-class machinists; general hands preferred, or must be A 1 on large lathe and planer. Enquire, 115 Plymouth st., Jersey City, N.J.

Experienced man desires position as foreman in brass foundry, plumbers or steam fitters; the latter preferred; references. BOX 157, AMER. MACHINIST.

Salesman and engineer, located at Chicago, wants to represent builder of first-class high and low speed engines; also water tube boiler. Address BOX 161, AMERICAN MACHINIST.

Mechanical draftsman (German), 28 yrs. old, with technical education and 8 years' experience (4 years in shop and 4 years in drafting room), wants position. BOX 159, AMERICAN MACHINIST.

A machinist, 6 years' experience, wishes position as adv. apprentice, with best work, under practical man, served 2 yrs' app., can make expert mach. in 2 more years. Address, BOX 150, AM. MACHINIST.

Wanted—Superintendent for foundry and machine shop, one conversant with medium to heavy machinery, and preferably with a knowledge of heavy electrical apparatus. BOX 136, AM. MACH.

Draftsman and machinist, age 27, 11 years' machine shop and drawing office experience, with good technical education, desires position at drafting or erecting; would not object to going on the road. BOX 163, AMERICAN MACHINIST.

Mechanical engineer, 25 years, exp. as foreman, supt., draftsman and designer in general and special machinery, wants similar position. Chicago preferred. Best of references. Address, Mechanical Engineer, 1074 N. Francisco ave., Chicago, Ill.

Superintendent of foundry and machine works desires to make a change. Has had technical education and excellent experience as draftsman, inspector, engineer of tests and supt.; can furnish first-class references. BOX 164, AMER. MACHINIST.

Wanted—First-class designer and pattern maker, also A1 machinist. Competent men can have steady employment and good pay. Must be experts and willing to work. Location in the West.
Address, BOX 155, AMERICAN MACHINIST.

A superintendent. A technically educated, practical machinist and draftsman, familiar with building high speed engines, making parts interchangeable by rapid process work. Must be good manager and willing to take off and hang up coat, and hustle out work. The right man can grow. Address, giving full outline of experience and references,
BOX 151, AMERICAN MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

Wanted—Offers for contract wk. on brass goods; only large shops need apply. Box 158, Am. Mach.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Machine forgings to order; special facilities for doing good work quick; send for estimates. The Coulter & McKenzie Machine Co., Bridgeport, Ct.

Light and fine machinery a specialty; model and experim'tal wk. strictly confidential; dra w's made and invent's perfected. Howe, 19 Gull st. Buffalo.

For Sale—Second-hand Baker pressure blower for foundry use; direct coupled to upright engine, in first-class condition. Address Ames Iron Works, Oswego, N. Y.

A manufacturing company with well equipped machine shop would like to add some light machy. or hardware specialty for manufacture. Address G. H. Dale, Silver Lake Co., Newtonville, Mass.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call or get list 17 B. The Garvin Mach. Co., 440 Canal st., N. Y.

For Sale—Piercing and forming punches, dies, jigs, lathe tools, milling cutters, gages and all the special tools and machinery for making the Hall Typewriter. Address National Typewriter Co., P. O. Box 5159, Boston, Mass.

Wanted—Machinist, molder or pattern maker with $2,500, to take one-third interest in a foundry and machine shop located in the garden of Minnesota; the best equipped shop in the Northwest. Address P. & K. Iron Works, Litchfield, Minn.

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Our catalogues of Books, on the above subjects, as well as every other practical subject, sent free to any address.

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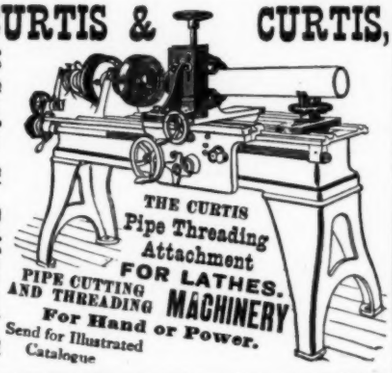
The first man in any town who buys one will be allowed an agent's discount and offered an agency, whereby he gets commissions that will pay for his wheel, or at least reduce the cost. Address HOWARD, 771 Summer Av., Newark, N.J.

CURTIS & CURTIS,

66 Garden St., Bridgeport, Ct.



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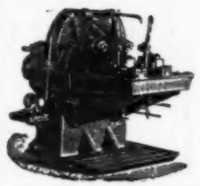

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ENGINEERING CONTRACTS

... AND ...

SPECIFICATIONS,

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By Prof. J. B. Johnson, M.I.C.E., M.A.S.M.E, M.A.S.C.E., Etc. 8vo, Cloth; pp. 417 x VII and an Index. Price, $4.00.

"Completeness characterizes the book and it readily takes an authoritative position on the subject with which it deals."—*Manufacturers' Record.*

"Each of the four divisions of this work is systematically treated in such a manner as to make the book very useful to an engineer or manufacturer who has anything to do with contracts for engineering constructions."—*American Machinist.*

"The first part is a most desirable addition to an engineer's library, the arrangement appearing to be both concise and complete. The details of advertising for bids, guarantees, forms of proposal, etc., which constitute part second, contain many suggestions and ought to prove very useful. . . . . This work is certainly one of the most interesting that could be added to the library of the engineer."—*Electrical Engineering.*

"Professor Johnson's 'Engineering Contracts and Specifications,' falls into the category of valuable, and, after a short acquaintance, indispensable engineer's reference books; plainly and tersely written, excellently arranged, conservative in statement and for the most part treating the subject matter thoroughly, it is unique in that, while appealing more directly to the engineer and the student, it is, nevertheless, almost as necessary to the contractor and the purchaser. . . . The book abounds in valuable suggestions and sound advice. . . . The omissions, and they are few, are easily condoned in the pleasure and profit one derives from Professor Johnson's thorough treatment of an important subject hitherto much neglected and about which there has been little information in an available or logical form."—*Electrical World.*

Sent postpaid on receipt of price by the publishers.

THE ENGINEERING NEWS PUBLISHING CO.,
101-105 Tribune Building, New York.

Manufactures.

At Shreveport, La., W. K. Henderson is about to erect a foundry and machine shop at a cost of $40,000.

The Dauphin Clothing Co., Harrisburg, Pa., will install new machinery for manufacturing clothing, etc.

The Star Steam Laundry, Harrisburg, Pa., is intending to install new machinery for its laundry business.

The Columbia Iron Co., Columbia, Pa., are going to install a lot of rolling mill machinery, together with boilers and engines.

The Iron City Fire Brick Co. has been incorporated at Pittsburgh, Pa. A large plant will be built there as soon as possible.

H. A. Meck Wood Working Co., Weatherly, Pa., will engage in the wood working business, and are about to place new machinery.

The Watts open hearth basic steel plant will begin operations at once. It will employ 600 men, and is located at Middleboro, Ky.

The Ætna Standard Steel Co., of Bridgeport, O., will erect an open hearth steel plant to manufacture steel for its tin plate department.

The American Anthracite Co., Philadelphia, Pa., has been incorporated; capital $200,000. This company will place an entirely new plant.

The Valentine Iron Co., of Bellefonte, Pa., will build a large new saw mill. It will be the latest and most complete saw mill in this section.

The Reading Straw Works, Reading, Pa., will engage in the manufacture of straw hats, and will place new machinery for this line of work.

M. M. Cross, of Petoskey, Mich., will sink ten shafts in the copper fields. Engines, pumps, drilling and hoisting machinery and cars will be placed.

The Franklin Electric Co., of Franklin, Pa., are adding quite a number of improvements to their electric light plant. New boilers will also be added.

The Saginaw Coal Co., Saginaw, Mich., will sink several new shafts at once. Engine, drilling and hoisting machinery and pumps and cars will be installed.

The Capital City Shoe Mfg. Co., Ltd., Short and South streets, Harrisburg, Pa., will enlarge their plant, and install a large lot of new shoe machinery.

The D. Willcox Manufacturing Co., Mechanicsburg, Pa., are increasing their plant and will place new machinery. They manufacture bicycle forgings, etc.

The Steelton and Paxton Flouring Mill Co., Harrisburg, Pa., will increase their immense plant by placing more new machinery in their flour and feed establishment.

The Industrial Works, Bay City, Mich., will install several new lathes soon. They are rushed with orders, among them being two wrecking cranes for Norway.

The Waltham Mfg. Co., of Waltham, Mass., are to enlarge their shops for the manufacture of the Orient cycles. They will probably put in a line of tools for drop forgings.

Bousfield & Co., Bay City, Mich., will enlarge their woodenware works; a building 50 x 200 is being erected. Pail, tub and chair manufacturing machinery will be installed.

The John Dunlap Co., of Pittsburgh, Pa., have purchased five acres at Homestead, Pa., and will erect a large factory for the manufacture of tinware and galvanized iron ware.

The Fanning Bicycle Chain Co., Keokuk, Ia., have removed to their new brick building, and will increase their facilities for the manufacture of their patented roller-bearing bicycle chain.

The Pittsburgh and Clearfield Mineral Wool Co., Pittsburgh, Pa., will erect an immense plant for the manufacture of fire brick, vitrified paving brick, etc., and will install a full line of machinery.

The Milliken & Sebley Torpedo Co., Pittsburgh, Pa., were just granted a charter to manufacture nitro-glycerine, dynamite, powder and explosives, and machinery for this purpose will be installed.

The Davis & Egan Machine Tool Co. have closed a contract with the Stoddard Mfg. Co., of Dayton, O., for their outfit of screw machines and hub machines for manufacturing one hundred bicycles per day.

The Whaley-Royce Co., Ltd., capital $100,000, with E. N. Whaley, Geo. Cooper Royce and Eli Gallop as first directors, to manufacture organs and pianos, has been formed to operate in Toronto, Canada.

The Crosby Manufacturing Co., of Buffalo, N. Y. (capital stock $200,000) are fitting up a large factory (floor area 35,000 sq. ft.), at the corner of Puffer and Masten streets, to manufacture a full line of bicycle fittings, pedals, etc.

One of the largest coal works in Eastern Ohio is to be established near Portland, O., by the Pittsburgh & Lake Erie Coal Company, in which 300 men are to be given employment. The mines will be equipped with electrical apparatus.

Mr. David Gessner, who has for years had all of his patent cotton and woolen machinery manufac-

tured at various machine shops, recently started a shop at 172 Union street, Worcester, Mass., and will hereafter produce his own machines.

The Alexander Duplex Tire Co., Ltd., have made application for a charter, capital $200,000, to manufacture pneumatic and other tires. J. W. Alexander, P. B. Alexander and Charles Knees to be directors, and place of business Toronto, Ont., Canada.

The National Vapor Stove Company, Cleveland, O., is about to branch out in a new line of industry. The company is at present engaged in perfecting plans for the manufacture of a steel range which, it is expected, will keep the shops running the year round.

S. M. York, Water street, Cleveland, O., has had plans prepared for a power block to be built on the west side of the river on both sides of the viaduct, between Elm and West River streets. The building as contemplated will be nine stories in height, and will be constructed of steel.

Frank Wehrle, Chas. T. Stark, H. L. Stark, A. S. Glasgow and R. H. Davies are the first directors in a company seeking incorporation, with a capital of $20,000, to be known as the Wehrle Brush Manufacturing Co., to manufacture brushes and woodenware. Place of business, Toronto, Ont., Canada.

Marcus Mason & Co. recently opened a shop for the production of coffee machinery at 172 Union street, Worcester, Mass. This firm takes the contract to equip a coffee plantation complete with engines, boilers and coffee harvesting machinery. They will place a new line of excellent machinery for this purpose.

The Lorain, Ohio, county recorder has received for record a mortgage for $1,500,000 given by the Sheffield Land and Improvement Co. to the Guarantee Trust Co., of New York. The filing of this mortgage is thought to mean that immediate steps will be taken toward building the Johnson Company's blast furnaces.

The Houghton-Buxton Company opened June 1st at 83 Exchange street, Worcester, Mass., a shop for the production of cold drawn bicycle fittings and similar work. The best and latest improved machinery has been used in equipping the shop, and employment for about 40 men is expected. Mr. Buxton is treasurer and manager.

A cash register company is organizing in the city of Columbus, O., for the purpose of competing with the National Cash Register Co. The new concern has patents which the old concern concedes do not infringe upon the latter's holdings, the inventions being those of Sern P. Watt, a former student of Ohio State University. The plan now is to convert the Columbus watch factory into a cash register manufactory. Contracts to that end have been made, and the manufacture of cash registers has already begun.

The Glen Falls Paper Co., of Glen Falls, N. Y., are making extensive alterations and additions to their plant, and on all their new buildings they are placing roofs supported by steel trusses. The trusses for the new work which they are now doing will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn. The new buildings will consist of a machine room, 67 feet wide and 217 feet long; a machine room, 52 feet wide and 167 feet long, and a finishing room, 50 feet wide and 100 feet long, and two boiler houses of somewhat smaller dimensions.

It has been decided by the Sharon Iron Works Company, Sharon, Pa., to build an addition to its works, which will double the capacity and increase the number of men two-fold. There will be a mammoth steel mill built, with a capacity of 1,500 tons per day, which will cost in the neighborhood of $500,000, the product of the mill to be used in the puddling department. In addition to this there will be a large rod and wire mill erected. They also decided to add 50 coke ovens to those now being erected. With this new plant in operation they will employ nearly 1,000 more men.

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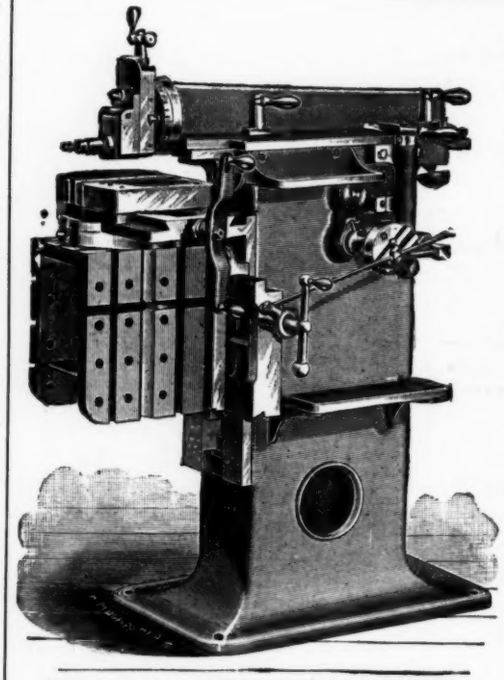

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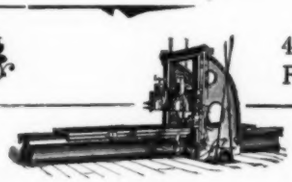

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We have received the catalog for 1895-96 of the University of Minnesota, Minneapolis, Minn. The catalog contains about 280 pages and is 5¾ x 8⅛ inches.

Purdue University, La Fayette, Ind., have sent us their annual catalog for 1895-96. It is 5⅛ x 7⅜ inches.

Davis Farrar Co., Erie, Pa., send us pamphlet illustrating and describing the "Shepherd" automatic engines, which are manufactured by them. The pamphlet is standard size, 6 x 9 inches.

Krajewski, Pesant & Co., 35 Broadway, New York City, send us a catalog, printed in Spanish, giving illustrations and descriptions of machinery used in working sugar. The catalog measures 5¾ x 8⅞ inches.

We have received the twentieth annual catalog of the Agricultural and Mechanical College of Texas. The catalog contains numerous illustrations of students at work in their respective branches, and is standard size, 6 x 9 inches.

The Q. & C. Company, of 700-707 Western Union Building, Chicago, send us their catalog of the McKee Brake Slack Adjuster for railway air brakes. The catalog, which is 3 x 6 inches, gives illustrations of the adjuster and a list of its advantages.

H. W. Johns Mfg. Co., 87 Maiden lane, New York City, send us catalog containing descriptions of packings, paints, cements, pipe coverings and other materials used in the machinery world. The catalog will be found interesting and is 4⅝ x 7 inches.

Mr. Otto Goetze, of 114 Broad street, this city, sends us a small pamphlet describing "Mannocitin," a composition which is used to prevent rust. The pamphlet contains opinions of users of the composition. It will be sent to those interested on application.

We have received from C. W. Hunt Co., 45 Broadway, New York, a treatise on the uses of rope for transmission of power, etc. The book contains a lot of valuable information, and will be found of interest to those who have to do with power transmission. It is 6¾ x 9¾ inches.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre street, New York, send us catalog B, which describes and illustrates the "Reeves" patent wood-split pulley clutch, for which they are the agents. The catalog is got up in handy form, and will be sent to those interested on application.

The Machinists' Supply Co., Chicago, Ill., send us a catalog illustrating and describing a large variety of tools used by machinists. The catalog contains numerous illustrations of vises, gages, calipers, drills, screw-plates, etc., etc., and will be found interesting. It has 305 pages, and is 5¾ x 9 inches.

We have received from the Union Gas Engine Co., 309 and 311 Howard street, San Francisco, Cal., catalogs illustrating and describing various forms of gas engines made by them, and adapted for the propulsion of launches, schooners and other small craft. The catalogs contain half-tone engravings of such vessels fitted with these engines, and measure 5¾ x 9¼ inches.

We are in receipt of the annual catalog of the Worcester Polytechnic Institute for 1896. The catalog gives a full description of the methods of instruction and the equipment of the school. As is well known, the policy of this school in its instruction shop differs from others in that its aim is, as far as possible, to produce commercial goods. The school distinctly disapproves of the now popular exercise system of shop instruction which produces pieces of no value in themselves. The aim of the Worcester Polytechnic shops is to keep commercial standards constantly before the student, not only in the product turned out, but in the organization of the shop itself, out of which grows instruction in shop administration, time-keeping, cost estimating, etc. The requirements for admission include algebra, geometry, advanced English, and French or German. Previous shop experience is not, apparently, accepted as a substitute for any of the above branches. The size of the catalog is 5¾ x 8⅝ inches.

Index to Advertisers.

	PAGE
Abbott, Wheelock & Co.	34
Acme Machinery Co.	Cover
Adams Co., The	38
Adt & Son, John	28
Akron Belting Co., The	21
Albro-Clem Elevator Co.	38
Almond, T. R.	37
American Gas Furnace Co.	30
American Injector Co	26
Ames Iron Works	40
Armstrong Mfg. Co., The	37
Ashcroft Mfg. Co	Cover
Audel, Theo. & Co.	21
Aurora Tool Works	38
Baird & Co., Henry Carey	34
Ball-Bearing Co., The	26
Barker & Co., William	21
Barnes Co., W. F. & John	25
Bates, Henry H.	28
Besly & Co., Chas. H	35
Bethlehem Foundry and Machine Co.	30
Bickford Drill and Tool Co.	33
Bignall & Keeler Mfg. Co.	33
Bilgram, Hugo	35
Blaisdell & Co., P	Cover
Bliss Co., E. W	30
Boston Gear Works	30
Bradford Mill Co., The	24
Bradley Co., The	25
Brainard Milling Machine Co.	39
Bremer Machine Co., Godfrey J.	34
Brown & Sharpe Mfg. Co.	Cover
Buffalo Forge Co.	Cover
Builders Iron Foundry	31
Bullard Machine Tool Co.	37
Burr & Houston Co.	34
Chicago & Northwestern Railway	40
Cincinnati Milling Machine Co.	Cover
Cleveland Machine Screw Co	38
Cleveland Twist Drill Co	31
Coburn Trolley Track Mfg. Co., The	34
Coffin & Leighton	30
Comstock, Wm. T.	28
Cooke & Co	29
Conover Mfg. Co.	24
Crescent Steel Co.	34
Curtis & Curtis	21
Cushman Chuck Co.	35
Dallett & Co., Thos. H.	28
Davis, W. P.	Cover
Davis & Egan Mach. Tool Co	39
Deane Steam Pump Co.	Cover
Detrick & Harvey Machine Co	Cover
Diamond Machine Co	35
Dietz, Schumacher & Boye	35
Dixon Crucible Co., Joseph	39
Durant, W. N.	30
Dyer & Driscoll	25
Egan Co., The	32
Elliott Chemical Works	38
Engineering News Pub. Co.	21
Erlandsen, J.	28
Evans Friction Cone Co	30
Ferracute Machine Co	30
Fifield Tool Co.	Cover
Fish Machine Works, H. C.	25
Fitchburg Machine Works	23
Flather & Co.	34
Foote, Barker & Co	25
Forbes & Co., W. D.	33
Frick Co., The	40
Garvin Machine Co., The	29
General Electric Co.	31
Gisholt Machine Co.	37
Goetze, O	25
Goodyear, S. W.	38
Gould & Eberhardt	Cover
Grant, George B.	26
Gray Co., G. A.	Cover
Guild & Garrison	Cover
Harrington & King Perforating Co., The	Cover
Hartford Steam Boiler Insp. and Ins. Co	24
Hendey Machine Co	22 and Cover
Henley & Co., N. W.	21
Hill, Clarke & Co.	34
Hoggson & Pettis Mfg. Co.	35
Hoppes Mfg. Co., The	37
Horton & Son Co., E.	35
Howard & Nichols Cycle Mfg. Co.	21
Hurlbut-Rogers Machine Co	Cover
Hyatt Roller Bearing Co.	31
Ingersoll Milling Machine Co.	34
Ingersoll-Sergeant Drill Co., The	40
International Correspondence Schools, The	39
Jenkins Bros.	24
Johnson Co., The	34
Johns Mfg. Co., H. W.	Cover
Jones & Co., B. M.	33
Jones & Lamson Machine Co.	Cover
Kempsmith Machine Tool Co.	Cover
Keuffel & Esser Co	35
Keystone Engine and Machine Works	38
King Mfg. Co.	34
Landis Bros	38
LeCount, Wm. G	34
Leland & Faulconer Mfg. Co	31
Lodge & Shipley Machine Tool Co.	Cover
Long & Allstatter Co.	32
Machinists' Supply Co.	26
Maris Bros.	Cover
Mason Regulator Co	40
McCabe, J. J.	29
McFadden Co.	26

(Continued on page 25.)

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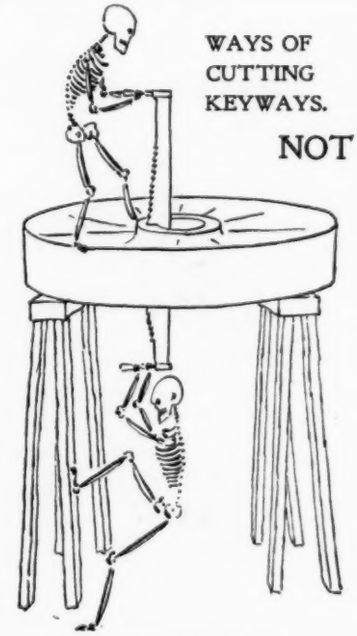

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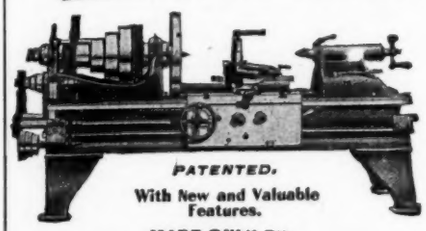

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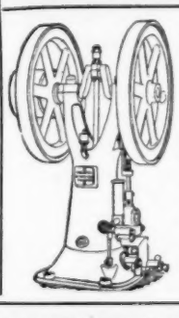

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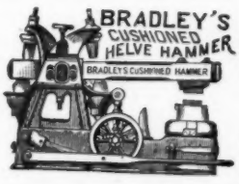

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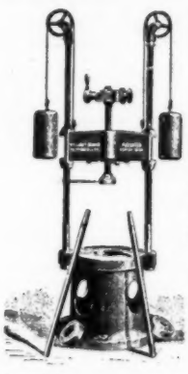

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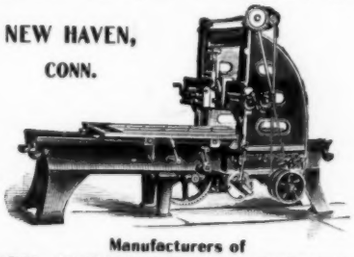

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INDEX TO ADVERTISERS—Continued.

	PAGE
Miner & Peck Mfg. Co.	Cover
Mitts & Merrill	24
Montgomery & Co	24
Morse Twist Drill & Machine Co.	31
Mossberg Mfg. Co.	28
National Chuck Co.	35
National Machinery Co.	27
National Pipe Bending Co.	37
New Haven Mfg. Co.	25
Nicholson File Co.	28
Niles Tool Works Co.	Cover
Niles Tool Works Co., N. Y. Branch	29
Nolte Brass Co.	35
Norman Co., J. J.	40
Norton Emery Wheel Co	31
Ohio Machine Tool Co., The	21
Oneida Mfg. Chuck Co.	35
Otto Gas Engine Works.	40
Passaic Smelting and Refining Co.	32
Peerless Drilling Compound Co., The	32
Penberthy Injector Co.	38
Pierce Engine Co.	40
Place Machine Co., George	29
Practical Publishing Co.	34
Pratt & Whitney Co.	23
Pratt Chuck Co.	35
Prentiss Tool & Supply Co.	29
Pryibil, P.	32
Quint, A. D.	35
Q. and C. Co.	33
Rand Drill Co	26
Reece, Edw. J.	38
Reed Co., F. E.	33
Reinecker, J. E.	39
Replogle Governor Works, The	25
Roots, P. H. & F. M.	Cover
Roth Bros. & Co.	32
Rutnagur & Co., M. C.	38
Sackmann, F. A.	28
Saunders' Sons, D	34
Sawyer Tool Co.	33
Schaffer & Budenberg.	27
Sebastian Lathe Co.	26
Sebastian-May Co.	34
Sellers & Co., Inc., Wm.	Cover
Seneca Falls Mfg. Co.	30
Shriver & Co., T.	32
Skinner Chuck Co	35
Slocomb & Co., J. T.	24
Springfield Gas Engine Co., The	40
Standard Tool Co.	35
Stark, John	37
Starrett, L. S.	37
Stiles & Fladd Press Co., The	30
Sterling Emery Wheel Mfg. Co.	25
Stirling Co., The	39
Strelinger & Co., Chas. A.	25
Sturtevant Co., B. F.	34
Taunton Locomotive Mfg. Co.	37
Taylor-Rice Engineering Co.	28
Timolat, J. G.	39
Toledo Machine & Tool Co.	33
Toomey, Frank	29
Trump Bros. Machine Co.	34
Warner & Swasey	Cover
Waterbury-Farrel F'dry & Mach. Co.	Cover
Waterbury Machine Co., The	24
Watson-Stillman Co., The	32
Webster Mfg. Co	24
Webster & Perks Tool Co.	21
Wedderburn & Co., John	Cover
Wells Bros. & Co.	Cover
Wells, Heber	30
Weston Engine Co.	40
Wetherill Machine Co., The James P	32
Whitcomb Mfg. Co.	40
Whiton Machine Co., D. E.	35
Wiley & Sons, John	23
Wiley & Russell Mfg. Co.	23
Wilkinson & Co., A. J.	32
Wilson, W. A.	32
Worcester Machine Screw Co.	28
Worcester Polytechnic Institute	34
Wyke & Co., J.	30
Wyman & Gordon	Cover

▲ ▲ ▲

Buyers' Finding List.

Adding Machines.
Grant Calculating Machine Co., Lexington, Mass.

Air Compressors.
Guild & Garrison, Brooklyn, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

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Balls, Steel.
Cleveland Machine Screw Co., Cleveland, O.

Bearings, Anti-Friction.
Ball Bearing Co., The, Boston, Mass.
Hyatt Roller Bearing Co., Newark, N. J.
Mossberg Mfg. Co., Attleboro, Mass.

(Continued on page 26.)

BUYERS' FINDING LIST—Continued.

Belting.
Akron Belting Co., The, Akron, O.

Belt Dressing.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Bicycles.
Howard & Nichols Cycle Mfg. Co., Newark, N. J.

Bicycle Tools.
Bliss, E. W., Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mach. Screw Co., Cleveland, O.
Davis & Egan Mach. Tool Co., Cincinnati, O.
Ferracute Machine Co., Bridgeton, N. J.
Garvin Machine Co., New York.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
Mossberg Mfg. Co., Attleboro, Mass.
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Weston Engine Co., Painted Post, N. Y.

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Detrick & Harvey Machine Co., Baltimore, Md.
Hill, Clarke & Co., Boston, Mass.
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Reece, Edw. J., Greenfield, Mass
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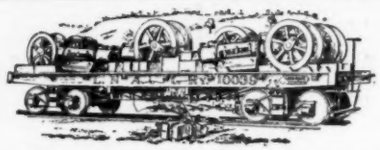

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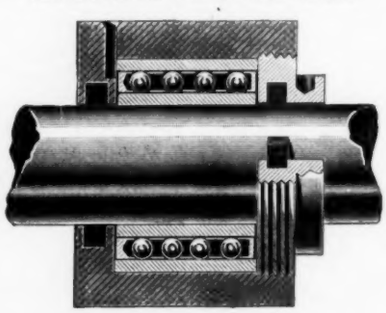

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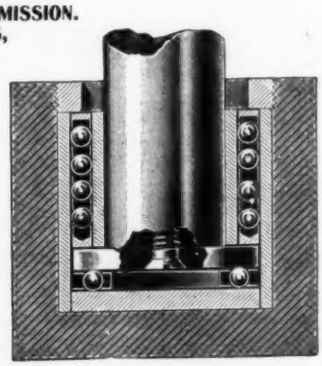

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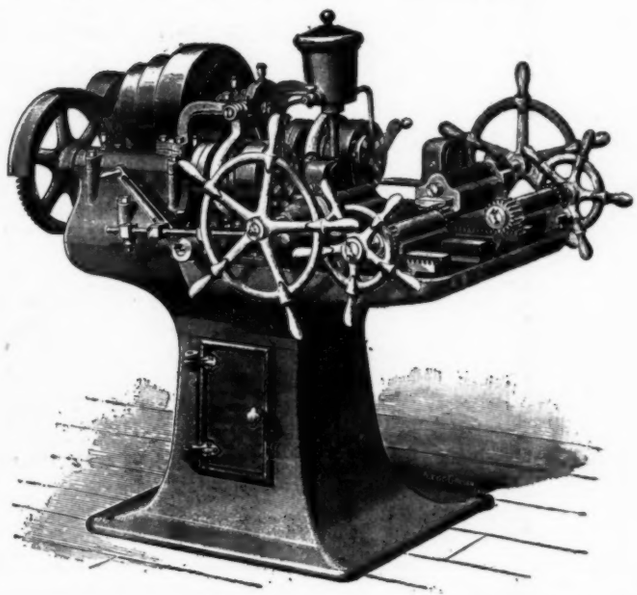

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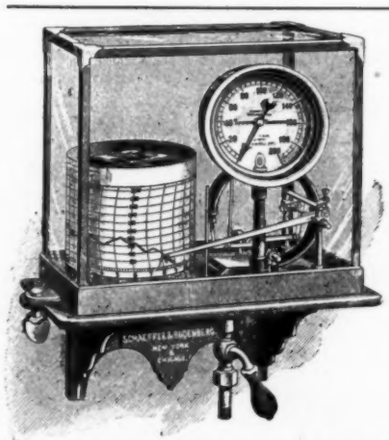

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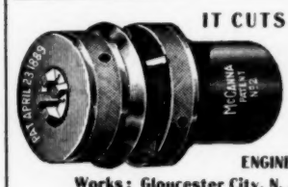

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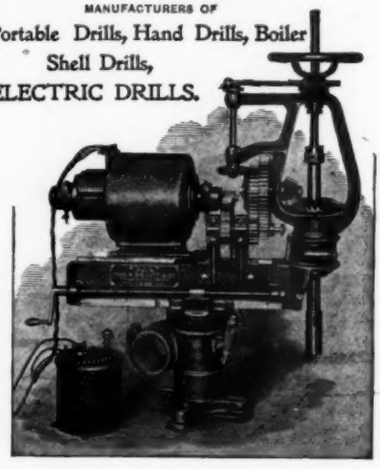

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37 " 30 " " "
51 " 18 " " "
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Portable Drill.
36 in. x 14 ft. Planer.
12 in. Shaper Traverse Head.
Gear Cutter, 54 in.
Milling Machine.
Cranes, Blower.

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14 in. x 6 ft., Prentice Bros.
14 in. x 6 ft., Jones & Lamson.
15 in. x 6 ft., Porter Machine Works.
16 in. x 6 ft., Blaisdell.
16 in. x 6 ft., Dexter Machine Works.
16 in. x 6 ft., Lodge & Davis.
16 in. x 8 ft., Fitchburg.
18 in. 10 ft., Blaisdell.
18 in. x 10 ft., Flather & Co.
18 in. x 6 ft., Bradford.
21 in. x 8 ft., Lodge & Davis.
22 in. x 8 ft., Blaisdell.
26 in. x 16 ft., Jones & Lamson.
34 in. x 20 ft., F. S. Perkins.

PLANERS.

17 in., Whitcomb, crank.
16 in. x 16 in. x 3 ft., Pratt & Whitney.
24 in. x 24 in. x 8 ft., Gray.
24 in. x 24 in. x 8 ft., Fitchburg.
26 in. x 26 in. x 6 ft., D.W. Pond.
22 in. x 22 in. x 5 ft., Pease.

SHAPERS.

6 in., Boynton & Plummer, for hand.
10 in., Hewes & Philips, crank.
10 in., Juengst, crank.
15 in., Hendey, friction.
15 in., Lodge & Davis, crank.
15 in., Smith & Mills, crank.
15 in., Chase, crank.
16 in., Gould & Eberhardt.

MISCELLANEOUS.

1-Spindle Garvin Profiler.
25 in. Pond Drill Press.
No. 2 4-Spindle Pratt & Whitney Drill.
No. 20 Hibbard Power Press.
No. 2 Pratt & Whitney Automatic Bolt Cutter.
No. 2 Garvin Automatic Gear Cutter.
21 in. Prentice Drill Press.
No. 1 Garvin Lincoln Miller.
No. 3 Garvin Lincoln Miller.
Prentice Bros. Suspension Drill.
No. 1 Pratt & Whitney Screw Machine.
No. 13 Brown & Sharpe Screw Machine.
No. 2 Springfield Tool Grinder.
No. 2 Garvin 3-spindle Drill.
Slate Automatic Gear Cutter.
3-8 in. Adt. Rotary Riveter.
No. 2 Diamond Polishing Lathe.
3 in. Armstrong Pipe Machine.
26 in. New Haven Drill.

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1 16 in. x 6 ft., Dustin Eng. Lathe.
3 18 in. x 6 ft., L. & D. Eng. Lathe.
1 19 in. x 6 ft., Fifield Eng. Lathe.
1 20 in. x 11 ft., L. & M. Eng. Lathe with Shafting tool rest.
2 21 in. x 10 ft., Pratt & Whitney.
1 23 in. x 10 ft., White Eng. Lathe.
1 27 in. x 10 ft., Dustin Eng. Lathe.
1 27 in. x 12 ft., Wood & Light.
1 28 in. x 12 ft., Wood & Light.
1 28 in. x 16 ft., Eng. Lathe.
1 30 in. Lodge & Shipley, gear blank and pulley tur. and bor.
1 36 in. x 12 ft., Geared Eng., heavy
1 32 in. x 13 ft., B. & D. triple Gd. S. C. comp. rest.
1 40 in. x 16 ft., geared plain turn'g.
1 48 in. x 18 ft., Gay & Silver.

PLANERS.

1 16 in. x 16 in. x 5 ft., Hand.
2 24 in. x 24 in. x 4 ft., Pond.
2 24 in. x 24 in. x 4 ft., W. & L.
1 24 in. x 24 in. x 7 ft., L. & M.
1 28 in. x 28 in. x 8 ft., G. & S.
1 30 in. x 30 in. x 8 ft., S. & S.
1 32 in. x 32 in. x 10 ft., W. & L.
1 32 in. x 10 ft., Open Side.
1 36 in. x 36 in. x 10 ft., New Haven.
1 36 in. x 36 in. x 18 ft., William Sellers.
1 38 in. x 38 in. x 10 ft., Aldrich.
3 48 in. x 32 in. x 6 ft., Pond, with two heads, new pattern.

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6 Sensitive Bench Drills.
4 Suspension Drills, Pond.
1 10 in. two-spindle Sensitive Drill
1 22 in. back-geared Drill.
1 34 in. back-geared Drill.
1 36 in. Gap Drill, power feed.
1 3-spindle Pratt & Whitney, adj.
2 3-spindle Sensitive, adjble.
1 Quint Turret with tapping attachment, six-spindle.
1 4 ft. arm Radial, Hilles & Jones.

SHAPERS.

1 15 in. Crank.
1 12 in. Traveling Head.
1 9 in. William Sellers, trvg. hd.
1 13 in. Bement & Sons, trvg. hd.
1 12 in. Hewes & Phillips, heavy.

BORING MACHINES.

2 No. 2, Bement & Miles, Hzl.
1 No. 2, Pedrick & Ayer Cyl. Borer.
1 30 in. Stevens Pulley.

SCREW MACHINES.

1 No. 2, Pratt & Whitney, plain.
1 No. 2, P. & W. W. F. Oil Pump.
1 No. 3, P. & W., f. c. hd. bk. gd., p. f. to turret slide oil pump.
1 18 in. F. & W., Turret Head Chucking Machine, oil pump.

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1 No. 5, Springfield Water Tool Grinder.
1 No. 2, L. & F. Tool Grinder, two wheels.
1 No. 6, Diamond, surfacing att.
1 No. 3, Universal Cutter Grinder.
1 No. 1, Diamond Unival. Grinder.
1 Brainard Cutter Grinder, on col.
1 P. & W. Forming Tool Grinder.

POWER PRESSES.

1 No. 95, Bliss Double Pitman.
1 No. 4, C. & M., single action.
1 No. 30, Bliss, single action.

MISCELLANEOUS.

1 2-spindle Profiler; Edging Mach.
1 4 in. H. & R. Cutting off Mach
10 Bench Vises, various sizes.
1 48 in. Gear Cutter.
1 No. 1, Warner & Swasey Vertical Miller.
1 C. & C. Electric Motor, 50 K. W. Generator.
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Penberthy Injector Co., Detroit, Mich.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Keyway Cutter.
Baker Bros., Toledo, O.
Mitts & Merrill, Saginaw, Mich.

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Blaisdell & Co., P., Worcester, Mass.
Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg Co., Providence, R. I.
Bullard Machine Tool Co, Bridgeport, Conn.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dietz, Schumacher & Boye, Cincinnati, O.
Fifield Tool Co., Lowell, Mass.
Fish Machine Works, H. C., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Gould & Eberhardt, Newark, N. J.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
McCabe, J. J., New York.
McFadden Co., Philadelphia, Pa.
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Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sebastian Lathe Co., Cincinnati, O.
Sebastian-May Co., Sidney, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark, John, Boston, Mass.

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Machinists' Supply Co., Chicago.
Montgomery & Co., New York.
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Standard Tool Co., Athol, Mass.
Starrett Co., The L. S., Athol, Mass.

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Adams Co., The, Dubuque, Iowa.

Milling Cutters.
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Cincinnati Milling Machine Co., Cincinnati, O.
Erlandsen, J., New York.
Garvin Machine Co., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Reinecker, J. E., Chemnitz-Gablenz, Germany.
Starrett, L. S., Athol, Mass.

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Brainard Milling Machine Co., Boston, Mass.
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Cincinnati Milling Machine Co., Cincinnati, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Forbes & Co., W. D., Hoboken, N. J.
Garvin Machine Co., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Kempsmith Machine Tool Co., Milwaukee, Wis.
Leland & Faulconer Mfg. Co., Detroit, Mich.
McCabe, J. J., New York.
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Niles Tool Works Co., New York.
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Harrington & King Perforated Metal Co., The, Chicago, Ill.

Phosphor Bronze.
Phosphor Bronze Smelting Co., Ltd., Philadelphia, Pa.

(*Continued on page 30.*)

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Saunders' Sons, D., Yonkers, N. Y.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Detrick & Harvey Machine Co., Baltimore, Md.
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Flather & Co., Nashua, N. H.
Garvin Machine Co., New York.
Gray Co., G. A., Cincinnati, O.
McCabe, J. J., New York.
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Niles Tool Works Co., New York.
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Prentiss Tool & Supply Co., New York.
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Morse Twist Drill & Machine Co., New Bedford, Mass.
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Wells Bros., Greenfield, Mass.
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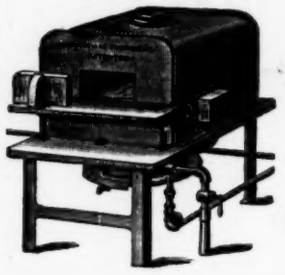
(Continued on page 31.)



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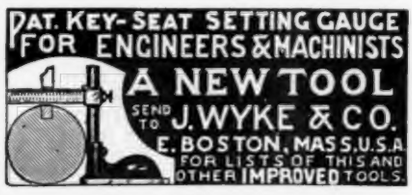
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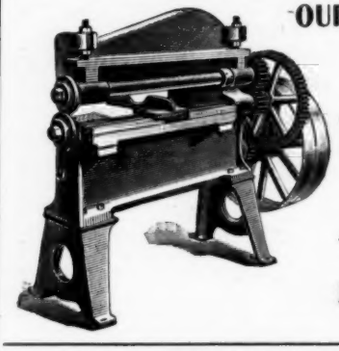

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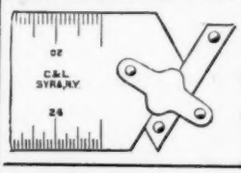

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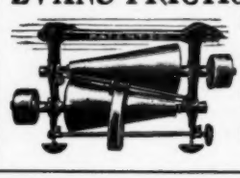

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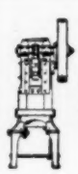

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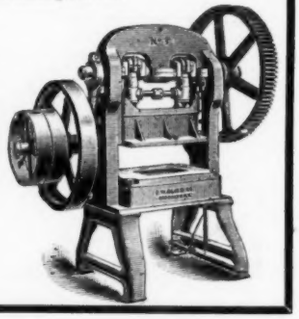

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Davis & Egan Machine Tool Co., The, Cincinnati, O.
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Flather & Co., Nashua, N. H.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
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McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Ohio Machine Tool Co., The, Kenton, O.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Shears, Rotary.
Bethlehem Fdy. & Machine Co., South Bethlehem, Pa.

Slotters.
Betts Machine Co., Wilmington, Del.
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Toledo Machine & Tool Co., The, Toledo, O.

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Sackmann, F. A., Cleveland, O.

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Crescent Steel Co., Pittsburgh, Pa.
Johnson Co., The, Johnstown, Pa.
Jones & Co., B. M., Boston, Mass.
McFadden Co., Philadelphia, Pa.

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McFadden Co., Philadelphia, Pa.
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Coburn Trolley Track Mfg. Co., Holyoke, Mass.

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Almond, T. R., Brooklyn, N. Y.

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Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Cleveland Machine Screw Co., Cleveland, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Garvin Machine Co., New York.
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Hill, Clarke & Co., Boston, Mass.
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Lodge & Shipley Machine Tool Co., Cincinnati, O.
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Niles Tool Works Co., Hamilton, O.
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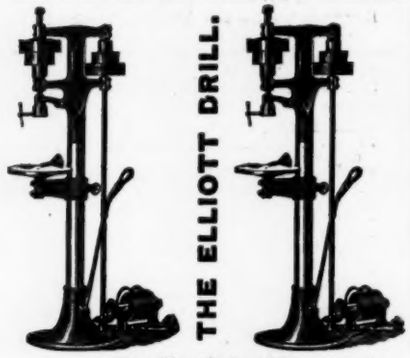

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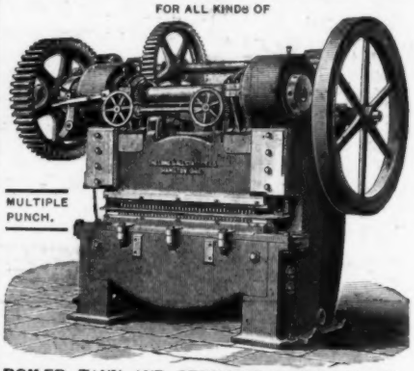

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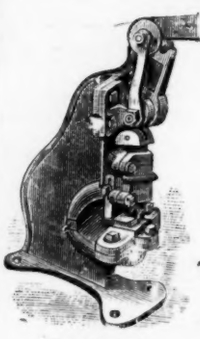

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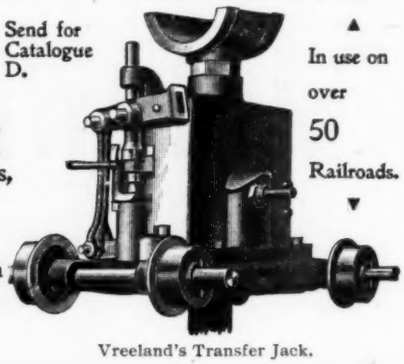

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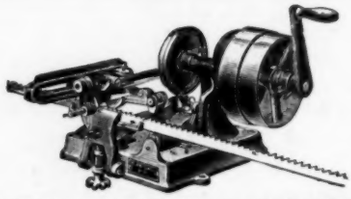

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